EXE

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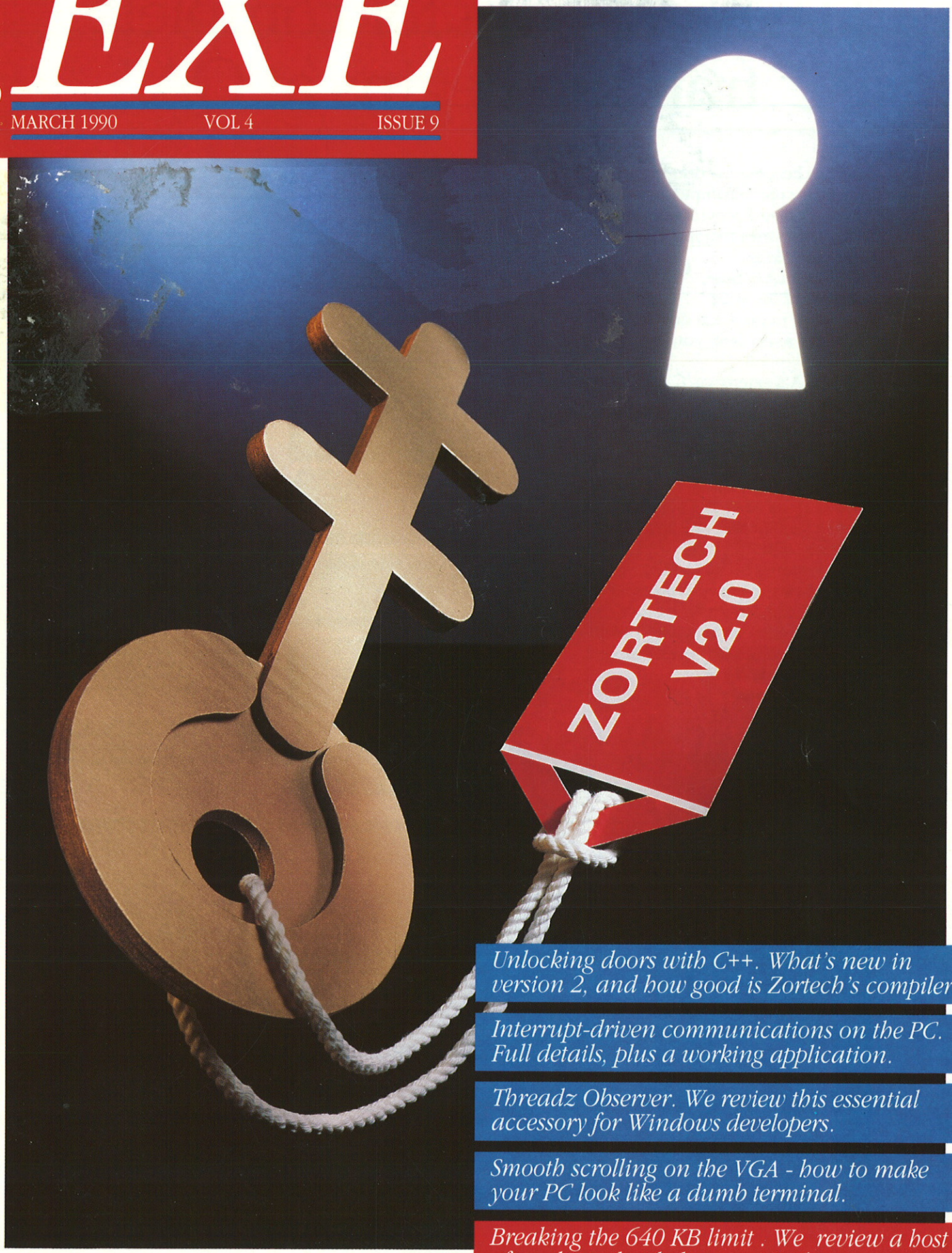
The Software Developers' Magazine



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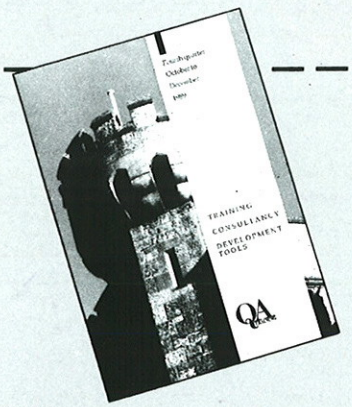

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Reacting to Readers
Our annual Reader Survey gives us an insight into the tools, methods, language and hardware that is being used, and that will be used in the process of software development.

We aim to keep in touch with software developers as much as possible. For this reason, we hold twice-yearly meetings at the .EXE offices and around the country, where readers can talk directly to the editorial staff and suggest ways in which the Magazine could be improved.

Knobbage and Chips

Because of what Americans would probably call an 'on-going geographical situation', I have to drive across London twice a day, between my home in the east and the office in the west.

I use the hour's journey in the morning as a time to relax, and to think of ideas for the Magazine. The amount of traffic isn't normally too bad, as I tend not to leave home until quite late (as you'll know, if you've ever called the office before 10.30am).

One subject that I think about quite often is the home of the future. What will our houses and offices be like, say, a dozen years from now? Probably much the same as today, I'd venture to suggest. Except, that is, for the amount of knobbage.

Knobbage is a term that's normally applied to hi-fi gear. As you'd expect, it's a measurement of the amount of knobs and switches on a piece of equipment. If you think that today's home has a high knobbage quotient, then just wait until you see what's round the corner.

In a couple of years or so, the remote control unit for the house should be in wide circulation. A prototype of this was shown on a BBC documentary recently. The control box for the system sits on a shelf at home, connected to the mains, and to a (ex-directory, preferably) telephone line. The remote control unit is pocket-sized and battery operated. It contains a number of buttons and some LEDs. Wherever you happen to be, just use it to squirt some tones down the nearest phone, and you can open the curtains, turn on the oven or the VCR, turn up the heating and so on. The system is bi-directional, and the LEDs can show you whether the dinner's cooked, whether the burglar alarm is working. You get the idea.

Also set to increase the knobbage count in the average home is the electronic mail terminal. Personally, I find email extremely useful. A number of .EXE's regular contributors are online with Cix, and this makes it very easy for them to send articles, in machine-readable form to me at the Magazine. They can also send me executable files, and I can send them utilities if, for example, they need to be able to produce screen dumps.

Certain people in the office are not as enamoured of Cix as I am. They feel, justifiably I suppose, that the world will become a mighty strange place if we all preferred to stay at home and press buttons all day, instead of going out to work, or to the post office.

The increase in world knobbage is already having a profound effect, and this is where I get back to talking about my hour's drive to and from the office every day. A year or so ago, if I was in a good mood and slowed down to let another driver out of a parking space, he'd raise his hand to say 'thank you'. Sometimes, he would lower his window, and actually put an arm out, and a thumb up. All of this has gone, now.

Nowadays, there are automatic ways of saying 'thank you'. In London at least, it has become quite common to give a couple of flashes of your hazard warning lights, just after someone has made way for you on the road. No more the raised hand, the protruding thumb or the quick wave. No more the smile in the rear-view mirror. Just a quick press of the switch with the red triangle on it, and they're away. If this is what the electronic revolution is doing for drivers' social skills, then perhaps my colleagues are right to scorn my love of electronic mail and home shopping.

How long it will take for new cars to have a custom 'thank you' button?

.EXE

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News

Son of Turbo

Borland has announced version 2.0 of Turbo Debugger and its associated tools. The new debugger will incorporate 'Reverse execution', which makes it possible to step through the program *backwards*, but presumably not very far; mouse support; program record and play-back (as found in the integrated environment of some Microsoft Quick languages) and 80286 protected mode operation. This last feature enables the bulk of the debugger program to live out of the way, up in extended memory, switching back into real mode to run the test program. Facilities like this are common for 80386 based machines, but this is the first time that I have heard of it being attempted in the trickier 80286 environment.

Bundled with the debugger is a new version of Turbo Assembler, dubbed TASM by its friends. TASM V2.0 is a multiple pass assembler, which enables it to knock out redundant NOPs - although if you need this feature, you must be desperate. There is also support for the handful of new instructions introduced with the 80486.

Turbo Profiler is an entirely new animal. Claiming to be 'the world's first interactive profiler', it will allow you to measure the performance of a program, viewing the results graphically. There are two techniques for gathering information; active analysis, where the programmer pre-specifies the routines which are to be monitored, and passive analysis, where the current position of the program is recorded at each clock tick, producing an overall picture of the program's activity. As Borland says, profilers are powerful tools which tend to be a bit fiddly to set up and use, so it will be interesting to see how this class of utility benefits from the Turbo touch.

The Turbo Debugger & Tools package is set to ship in Q2, priced at £129.95. There will be a £49.95 upgrade for owners of version 1.0 and the Professional language packages. One final point. Borland's press literature also mentions object-oriented programming support as a new feature; since the current version of the debugger already supports Turbo Pascal V5.5 classes, presumably this is a reference to the forthcoming, but so far unannounced, Turbo C(++) V3.0.

HALO

Media Cybernetics' graphics library HALO has been upgraded. Version 3.0 includes device drivers for some fancy hardware, such as Canon's IX-30 scanner, and a system called the 'Willows Publisher's VGA', which is a combination extended VGA card and frame-grabber. The library is available with various different bindings, such as Microsoft C and FORTRAN, Turbo Pascal and even Ada. An OS/2 version of the library is supposed to take advantage of that environment's multi-tasking capabilities. Presumably, if you make a call which involves a lot of processing, the library routines create a new thread to do the drudge and return control to the caller. This allows the programmer to construct some nifty 'always ready' user interfaces, without complicating his own code.

Needless to say, prices vary according to the version of HALO that you want. The US price for an MS-DOS single-language version of the library is $395. The OS/2 version costs $695, while the Ada versions cost up to $995. HALO should be available from your dealer; if not, call Media Cybernetics in the US on 0101 301 495 3305 .

FORTRAN 4

Salford Software Marketing, best-known for its native 80386 FORTRAN compiler FTN77/386, has gone one up on itself. Like its predecessor, FTN77/486 uses proprietary DOS extender technology to provide virtual memory and multi-gigabyte linear addressing. The new compiler is also fully source and object code compatible with the older product.

But here's a mystery. A FTN77/486 compiled program is supposed to run twice as fast as the same code compiled with FTN77/386 - *both* programs running on the same 486-based machine. How can this be? We know that, for all practical purposes, the 80486 has an identical instruction set to an 80386/80387 combination. So the 486 cannot be making use of any fancy new opcodes. An SSM spokesman was charmingly candid about the answer. The 386 version detects if it is running on a 486. If it is, then a few caches get disabled. So now you know. The compiler costs £895.00, SSM's phone number is 061 745 5678.

Clisp

The Clisp library contains a set of C functions which emulate the LISP environment. The function names have a familiar ring to them: cdr, cddr, cdddr and even cddddr. The foundation of the system is a data type which emulates the LISP list of objects. The idea is that applications realised in LISP can be quickly ported to the faster language. Clisp is supplied as ANSI C source, so you can take it anywhere, and costs £295 from System Science (01 833 1022).

Hardboot

It's not uncommon to have multiple operating systems on your PC's hard disk - a different one in each partition. Hardboot is a £19.95 utility which throws up a menu at boot time. You get to select which OS to boot up, all without fussing around with the active partition, or using floppy disks or other tomfoolery. It's supposed to work with any OS from MS-DOS to PICK. Call ALLM Systems (0923 30150) for details.

Windows Quickie

You've read in these pages before, about the lengths that Microsoft goes to in order to prevent its programmers from including their names in products that they write. It would appear that the Windows development team have managed to sneak past the censors. If you have any version of Windows 2.1 or later, load up the desktop and then press F1, F5, F9 and F4, followed by the backspace key. A nice little window pops up, in which scrolls up the list of all the Windows programmers.

Meiko Users

An independent user group for users of Meiko Scientific computers has been formed. The group has already published the first issue of its newsletter 'Surface Noise', which is a well-produced glossy containing diverse articles from the analysis of protein with parallel algorithms to a discussion of what the group should be called. Members have already objected to my favourite, which is the Scientific Meiko User Group - SMUG. Details from Sarah Rippin, Meiko Scientific, 650 Aztec West, Almondsbury, Bristol, BS12 4DS.

Good Grammar

There is a new version of Grammatik, the excellent program which criticises the English in word processor files that it is given. All common word processors are supported. Grammatik IV costs £89 and is distributed by Riva (0420 22666).

OS/2 2.0 SDK

The software development kits for OS/2 V2.0 are now shipping. At last, there is an official Microsoft product that supports native 32-bit code. Also, the DOS box now uses the chip's virtual 8086 mode, so you get more than one DOS box, and it doesn't fall over as often as it does with V1. According to Microsoft, OS/2 2.0 will run all OS/2 1.0, 1.1 and 1.2 programs without alteration.

The SDK is available only from Microsoft, although it will allow development of applications for IBM's OS/2 2.0 as well. UK price is £1700, or £5500 for four. The contents include a beta version of OS/2 2.0 and full documentation, as well as a pre-release copy of Microsoft C 6.0 and MASM 6.0. These are the 32-bit versions of Microsoft's languages, which we will review fully when they are in final form. Before you get all excited, C++ doesn't happen until version 7.

Oh, and start saving up for some new hardware. You need 6 MB of RAM, EGA or VGA, and a 60 MB hard disk to install the SDK.

LISTPACK

Mirabilis Software has sent us a copy of LISTPACK. This is 'an innovative new programming language, based loosely on LISP'. Based quite closely on LISP, it seems to me. Here is a taste of LISTPACK code:

```
(if (<> (evalexp (rand1 e)) 0)
    (evalexp (rand2 e))
    (evalexp (rand3 e)))
```

The underlying idea seems to be that LISTPACK is a sort of pragmatic implementation of LISP on the 80x86 processors. The manufacturer suggests that LISTPACK could be used for prototyping applications, and developing functions quickly in a 'try it and see' style. The product, which runs in 512 KB on any 80x86 PC, is available from Mirabilis Software, who are on 0256 29839.

Translation Assistant

NEOW are best known for distributing Actor, the high-level language for writing Windows applications.

The latest string to NEOW's bow is the Resource Translation Assistant. This automatically translates the text used in a Windows application from one language to another.

The system is not as clever as it would first appear, however - you have to set up custom dictionaries in house. RTA then picks the right dictionary for the right language, and it also allows you to reuse your favourite phrases across all your applications. The product costs £395, and NEOW are on 06286 68334.

Classy Library

When Turbo Pascal V5.5 first appeared, there was much dark murmuring among the object oriented community, which went along these lines: 'It's all very well producing an OOP Pascal, but the thing is stuff-all use without some class libraries.' Now, many months later, a US company, Turbo Power Software, has at last shipped Object Professional, an OOP version of its existing library Turbo Professional.

As you would expect in this sort of library, there are classes for handling all aspects of WIMP. You get movable, overlapping windows with scroll bars, menus, and all the mouse support that you can eat. But there are many other tools. Printer output is dealt with at two levels; there are system level objects that control output via MS-DOS and BIOS calls, and much higher level printer drivers, which contain details of escape sequences, fonts and the like. A report object provides yet another layer of abstraction - it lets you set up fields within a printed report as though designing a data entry screen. Object Professional also includes objects for standard data structures (lists, queues and virtual arrays) and various system functions, including an intriguing sounding TSR manager. Anything that can conceal the entrails of setting up TSRs must be a good thing.

We only have US details for Object Professional at the moment. These are: the product costs $150, TPS's number is 0101 408 438 8608. Unless the company produces a separate version, users of Microsoft's 'Turbo compatible' QuickPascal will not be able to use the library, because of differences in syntax of object oriented language extensions and in the format of binary files.

Inside Postscript

If you don't already know, it is startling to discover that you can hook a terminal up to a Postscript printer, and start programming interactively, as though it were running some sort of FORTH. A new book, 'Inside Postscript', documents some murky corners, such as job execution and file I/O, left unilluminated by Adobe's pastel collection of texts. The book costs £35.50 including P&P from Headway Computer Products (0252 333575).

SoftICE UK

The SoftICE debugger, reviewed in .EXE's November '89 issue, has acquired a UK distributor - Hitex UK Ltd. The telephone number is 0203 692066. The price is £425 ex VAT including shipping, which does not compare well with a price of $386 from the US manufacturer.

At last

It's official. The current draft of standard X3.159-1989, the ANSI C Standard, has finally been approved. The only thing remaining to be done is publication, which is probably only months away. If you can't wait for that, then the BSI will sell you a copy of the current draft - good enough for most purposes - with a free rationale (why they did it this way) attached. You won't get the rationale with the Real Thing. The BSI is on 0908 320856.

Chip Simulator

Avsim is a family of chip emulating programs that run on the IBM PC. All the most popular microprocessors and microcontrollers are covered, including the 8051 and the 64180. The simulations, which are based around a 'front panel' style text mode display, include the ability to define RAM and ROM boundaries. Call Comsol on 09323 52744 for further details.

Where's the Keyboard?

Sometimes, it would be useful to be able to run your PC without a keyboard. When it's running a rolling demo, perhaps, or acting as a network server, or controlling an external process. Unfortunately, most PCs will complain if you try to boot them without a keyboard (with the infamous 'Keyboard Error - press F1 to Continue' message). A Danish company by the name of EIVA has a solution. Their Phantom Keyboard is a tiny box that plugs into a keyboard connector, and fools the BIOS into thinking that a keyboard is connected. EIVA can be had on 010 45 86 282011.

FUNCky

FUNCky is a library of functions for Nantucket's Clipper compiler. The routines are diverse in purpose. There are calls to provide pop-up windows, pull-down menus and other sexy screen handling things. There is mouse handling, 43/50 line EGA/VGA screen modes, the ability to have up to 255 files open per process *without* MS-DOS V3.3 and even an EBCDIC to ASCII function. In all, there are over 400 routines.

We have mentioned FUNCky before, so this appearance is to announce that it now has a UK dealer, QBS Ltd (01 994 6477),which is charging £175 for the package. When Clipper 5.0 appears, registered users of FUNCky can receive an upgrade for the price of P&P. Oh yes: sharp-eyed readers will have noticed that QBS's phone number is the same as .EXE's. Lest you should suspect any funny business, QBS is an (independent) company operating from the same building. They seem like nice lads.

Well drawn

Programming with graphics can be terrific fun. However, when you need to produce a fixed image, things can get very tedious. It seems to take dozens of line-drawing calls to create the most trivial picture, and you have to keep stopping and running what you've got, to find out what it does. What you really need is something that lets you draw a picture on the screen, edit it, and only convert it into code when you have got it right.

AutoGraphic is a £49.95 package from PenguinSoft Ltd which does exactly this. Essentially a simple CAD package bolted to a code generator, it comes in two varieties, producing either Turbo C or Turbo Pascal code. The output is designed to be resolution-independent, so you can run it on any graphics card without adjustment. The program was originally designed as an in-house tool, used for superimposing graphical lines on top of Laser Disc Images. PenguinSoft's number is 02416 391.

Greenleaf

According to a recent survey that we carried out among .EXE readers, one of the most popular add-ons for C compilers are communications libraries. Greenleaf's CommLib, probably the most popular, is up to version 3.0. There are now over 150 functions in CommLib, including Kermit, Xmodem and Ymodem file transfer. Zmodem, the most popular protocol in use on bulletin board systems, because of its ability to restart an unsuccessful transfer , is conspicuous by its absence.

Other facilities that *are* present include filtering of incoming characters, Hayes modem control and XON/XOFF flow control. CommLib runs on the PC, XT and AT, and also on the PS/2. On the PS/2, it supports up to COM8, while it only knows about COM1 and COM2 on a standard PC. If you have one of those clever multi-port boards, it will support up to COM35.

The library provides interrupt-driven communications, rather than relying on the primitive support provided by the PC's BIOS. US price is $299, and no royalty payments are requested. The product comes with full source code. It should be available now, from your local dealer.

Watnow

Watcom, the Canadian company which produces compilers with teeth, has indulged in a bout of pre-announcing. Version 8 of the MS-DOS (if that's the right tag) C compiler will feature OS/2 and Windows support, conformance to IBM's SAA specification for C, an execution profiler (these seem to be flavour of the month) and yet more tweaks to the optimiser. The 386 version of the compiler, which requires the additional purchase of Phar Lap's DOS extender tools, is also being upgraded to keep it in line with its 16-bit brother. There will be a 386 source-level debugger, whose user interface will be identical to the MS-DOS original. Even Express C, the semi-integrated toy compiler given away with the optimising compiler, is to have its editor and debugger improved.

All this is sometime ahead, however. First shippings of Watcom C8.0/386 are scheduled for May of this year, the 16-bit version will follow one month later. Both compilers will be supplied in 'Standard' and 'Professional' versions; the cheaper packages will lack such goodies as the Profiler and OS/2 support. Pricing will be unchanged from V7.0 for the standard editions; the Professional versions will cost $495 and $1295 for 16-bit and 32-bit packages respectively. There will be various upgrade deals, including free upgrade to all registered purchasers of C7.0/386. Watcom has also announced a matching set of 16 and 32-bit FORTRAN compilers, which are to be ready at the same time as the C products.

Updated SNAP!
A few months ago, we mentioned the existence of SNAP!, a Shareware utility for documenting dBASE source code. The product's now up to version 4.0, which is said to be 25% faster and able to cope with larger files (and multiple source code modules). It knows about FoxPro, too. Details from your local bulletin board or shareware library.

Clean Backup
Datasave-aba V5.12 is a PC backup program with two unusual features. First, it works from OS/2 PM as well as MS-DOS. Its other trick is to incorporate a virus detector, which searches your disk for 59 known viruses and also reports programs containing references to INT 13H and INT 26H, the 'direct disk write' interrupts. The product costs £59 for the MS-DOS version and £179 for OS/2 (price increase threatened for the end of April). The distributor is IDS (01 631 0548).

All Change
Does your database application store London phone numbers? If so, are you ready for the change-over in May, when the 01 code becomes 071 or 081, according to the distance between the exchange and Charing Cross? If you still need a machine-readable look up table, to help in database conversion, call BT on 0800 800 873, between 9am and 7pm, and they'll send you a PC disk free of charge.

New from JPI
JPI has announced TopSpeed Pascal, an ISO-compliant compiler (with objects, of course). This is in addition to the new release of its Modula-2, reported here last month. Compatibility with Turbo Pascal will be achieved through the use of an automatic conversion tool. Expect the product to appear around June time.

C Testing
Two Dutch companies have produced a suite of test programs that claims to verify the ANSIness of a C compiler. HCR Corp and Associated Computer Experts claim that SuperTest verifies the performance of a C compiler 'through over 11,000 carefully constructed conformance tests, and stresses the compiler's capabilities and quality through more than 380,000 depth tests'. The suite is available in Europe through ACE, who can be reached on 010 31 20 6646416. The price is $32,000 US, which compares rather badly with the BSI's suite, which performs the same function. This currently sells for £1500.

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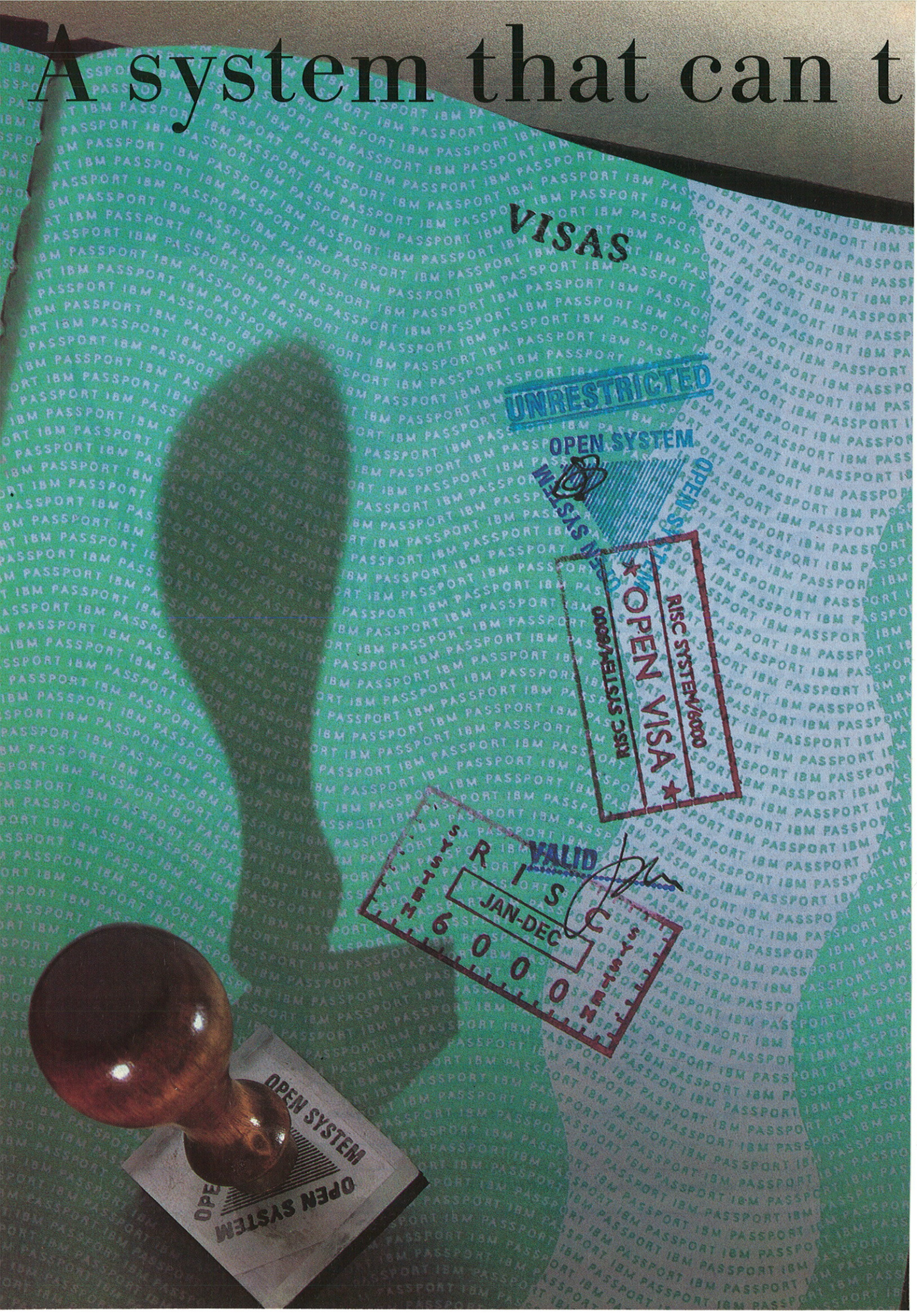
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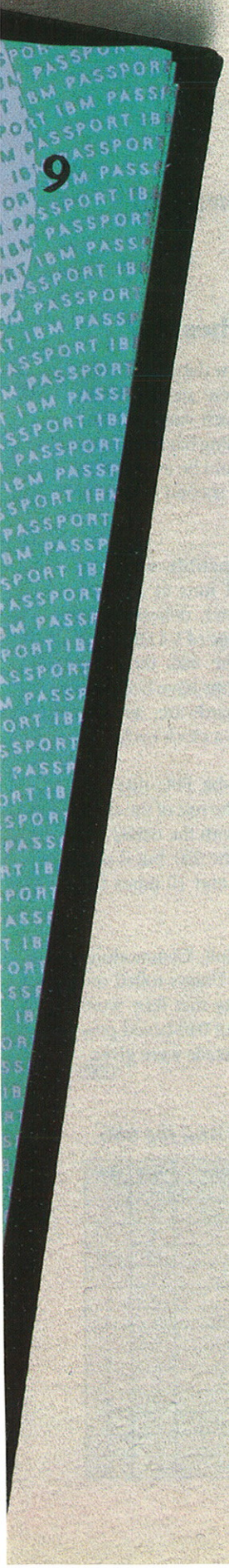

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Hardware Focus

Our monthly look at hardware, from a software point of view. This month, a new 486 machine, plus add-in processor cards and the 68040.

Another i860 Card

Last month, we mentioned the existence of IBM's Wizard card. This, as you'll remember, is an Intel i860 plug-in co-processor card for any MCA-equipped PC. The toolkit, included in the £10,000 price tag, lets you adapt your OS/2 source code so that certain routines or tasks are executed on the 860, while some remain on the standard 386 (or higher) processor.

Now, Myriad Solutions of Cambridge has produced a DOS-compatible 860 card that doesn't require OS/2, and doesn't require any alterations to your source code. You simply compile your program with the supplied compiler, and your program, when run, will be executed wholly on the 860.

At the moment, you don't get the option to farm out part of your code to the 860 and leave some of it on the machine's CPU - the 860 takes control of the program in its entirety.

The card comes with between 2 and 8 MB of cached RAM, expandable to 32 MB. Any portion of the card's RAM can be mapped into the PC's address space as extended or expanded memory, providing easy transfer between the two systems.

Myriad's own figures suggest that the average program will run around 10 times faster with their MC860 card installed, compared with the same program running on a standard 25 MHz 386 machine.

Pricing for a typical system is around £8500, and the product should be available now. Call Myriad on 0223 421181.

Epson Drivers

As any Epson employee will tell you, the problem with launching a new printer is that it takes months before software companies start to include drivers for it, with their product. To get around the problem, Epson is now doing the work itself, and has started publishing printer driver packs to accompany new models. The Company says that all new printers will have driver packs available. The drivers are not copy protected, and you are encouraged to make as many copies as you wish. Details from Epson (UK) on 0442 61144.

Cheapest 486

A couple of months ago, we were inundated with information from companies who were proud to be selling 386-based systems for under £1000. The equivalent figure for the 486, it would seem, is £5000, according to AMT. Their 486 machine, which they're calling the 'Personal Mainframe 425', starts at £5000 and contains twice the processing power of a 33 MHz 386 box. For the entry level price quoted above, you get 2 MB RAM, 40 MB hard disk, mono monitor and card, two serial and one parallel ports, keyboard, a 1.2 MB floppy drive and DOS 3.3. All you need to add is VAT, and the machines are available now. AMT are on 01 450 3222.

Colour Projection

If you demonstrate your software by using one of those projection-panel thingies on top of an overhead projector, you've probably cursed, silently, the fact that the panel only works in black and white, and you spent ages adding the colour to your program. If that's the problem, then In Focus Systems Inc have the solution. They have just produced the first colour projection panel. It has eight colours, 640 x 480 graphics, and works with everything from CGA to VGA. UK distributor is CRT Displays Ltd on 041 221 0044. The price is (wait for it) £4500.

Motorola Launches 040

Just to prove that we know there's life away from Intel processors, here are the details of Motorola's 68040, which was launched late last month. Initial testing has been completed, and the chip should be available in sample quantities by the second quarter of this year, at $795.

The 040 is fully compatible with the 68000,020 and 030, and runs at 25 MHz (faster speeds will follow), delivering 20 MIPS. It delivers an average of 3.4 MFLOPS, and peaks at 8. Like the 486, the most frequently used instructions have been implemented directly in hardware, as with RISC chips, to execute in a clock cycle.

The 040 includes an 80-bit FPU that can work concurrently with the rest of the chip. The FPU is compatible with the 68882 co-processor, as used with the 030, but is said to deliver between five and 10 times the performance.

At the launch, Apple, Bull, Commodore, HP, Nixdorf, Philips and Unisys rolled out their spokespeople to say that they were committed to bringing out 040-based products, though no other details were given. .EXE

Comparing the 040 and the 486.

Instruction	SOURCE	DESTINATION	68040	80486
MOVE	Rn	Rm	1	1
MOVE	Rn	mem	1	1
MOVE	mem	Rm	1	1
MOVE	mem	mem	1-2	none
Arith	Rn	Rm	1	1
Arith	mem	Rm	1	2
Arith	Rn	mem	1	3
Cmp/Tst	Rn	Rm	1	1
Cmp/Tst	Rn	mem	1	2
BSR			2	3
Bcc-taken			2	3
Bcc-not taken			3	1
DBcc-taken		Dn	3	7
DBcc-not taken		Dn	4	6

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Letters

We welcome opinions on any subject that is relevant to software development, especially feedback from articles published in .EXE. Please write to The Editor at 10 Barley Mow Passage, Chiswick, London W4 4PH. Unless your letter is marked Not For Publication it will be considered for inclusion on this page.

Dear Sir,

I have just finished 'checking out' the bugs in your article 'Here are the bugs: Turbo C 2.0' (.EXE Magazine, December '89) and am writing to let you know what I have discovered. Bug #1 is a real bug, but the compiler does warn 'Conversion may lose significant digits' at the `switch` statement.

Bug #2 is not a bug at all, as far as I can see. I am not sure why anyone would want to do `sizeof` on an arithmetic expression, but the results do seem reasonable. With the declarations

```
char c; float f;
```

then:

```
sizeof(+c) == sizeof(char)
```

is reasonable, since unary + does nothing, although probably not strictly correct;

```
sizeof(-c) == sizeof(int)
```

is as expected, since operands of type `char` are converted to `int` (K&R section 6.6);

```
sizeof(c+f) == sizeof(double)
```

is similarly as expected, since operands of type float are converted to double (K&R section 6.6 again).

I agree with Bug #3, and did not test Bug #4 since it looks like a minor problem - unlikely to cause me any trouble.

Bug #5 is a real bug. However, the example and description given do not show its true nature. The bug is illustrated with the following code fragment:

```
unsigned short lus = 40000U;
int ssi = 4;
printf("lus ssi = %d\n", lusssi);
```

The `printf()` call should print '1', but actually prints '0'. This is because, when using a relational operator with one operand an `unsigned short` and the other an `int`, Turbo C incorrectly generates code for a `signed` relational operation. I have done a few experiments and, as far as I can tell, the bug affects only this combination of operand types and only relational operators. My suggested fix is not to use `short` at all, just to be on the safe side.

I did not test Bug #6, for the same reasons as Bug #4.

Brian D Gregory
Reading
Berkshire

Neil Martin, author of 'Here are the Bugs', replies:

In Bug #1, Brian correctly states that Turbo C warns 'Conversion may lose significant digits' when the example is compiled. This is due to my unfortunate choice of constants for `array` *in the example. These were all* `unsigned longs` *- ie too big to be represented as* `signed longs` *- and, since conversion from* `unsigned long` *to* `long` *is implementation defined, Turbo C had a legitimate excuse to print its message. The following code shows a revised version of the Bug #1 code. The constants have been reduced to fit the* `long` *array, but Turbo still prints its warning message, and the* `switch` *still fails (in fact, Turbo C is truncating* `longs` *to* `ints`*).*

```
#include<studio.h>
main()
{
 static long array[] =
  { 0xf010000, 0xf020000,
  0xf030000, 0xf040000};
 int i ;
 for(i =0 ; i<=>3; i++)
 {
  switch( array[i] )
  {
   case 0xf010000:
   puts("case 1");
   break;
   case 0xf020000:
   puts("case 2");
   break;
   case 0xf030000:
   puts("case 3");
    break;
   case 0xf040000:
   puts("case 4");
    break;
    default:
 puts("We  shouldn't be
here");
  }
 }
}
```

In the case of Bug #2, evidently I did not make myself clear. What I should have said was:

```
char c;
if (sizeof(+c) != sizeof(c))
 complain();
```

Both `+c` *and* `-c` *should undergo integral promotion, giving a result equal to* `sizeof(int)`.

At the very least, unary plus and minus should be symmetrical. Also, the ANSI Standard says quite clearly that the sum should be promoted to type `float`*, not* `double` *- this is one of the things that has changed between the two editions of K&R.*

As for Bug #5, I must concede a hit: the bug affects all relational operators, and not the remainder operator. It occurs when you use the type `short`*. I agree with Brian's diagnosis, but not his solution. Surely it would be better to avoid mixing* `signed/unsigned` *types with relational operators. Avoiding* `short` *would surely introduce portability problems.*

Finally I would like to thank Brian and everybody else who responds to the 'Here are the Bugs' articles - every snippet of knowledge of what is good and bad in our compilers is valuable. However, I admit to finding it slightly amusing that Brian dismisses a bug as unimportant, just because it does not affect him.

Dear Robert,

Readers may be interested to know about the following two bugs we have discovered in Turbo Basic V1.1, especially since there

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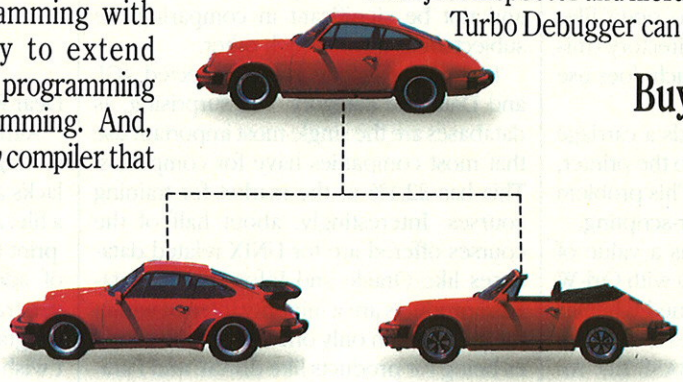

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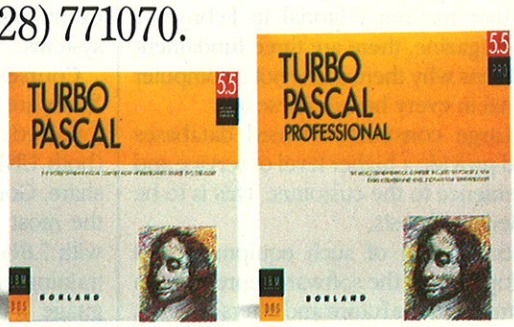

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BORLAND

Borland International (UK) Ltd.,
8 Pavilions, Ruscombe Business Park
Twyford, Berkshire RG10 9NN

CIRCLE NO. 785

is now no new release from Borland in sight. Superfluous spaces in numeric DATA statements cause problems if the compiled program is run on a PC with a maths co-processor. For example, in:

```
DATA 37, 56
READ I%, J%
```

I% will be read correctly, but J% will give a syntax error as if it is trying to read '56'. The second problem occurs on any machine and tends to result in error 242 - String/array memory corrupt, or undetected corrupt string variables. It is caused by using the graphics PUT statement within a procedure or multi-line function when in a high-resolution graphics mode (SCREEN 9 or above).

Simon Morgan
Colin Buchanan and Partners
London W2

Dear .EXE,

The following are some Foxplus bugs/undocumented features which may affect those converting from dBASE. I understand that they are also present in FoxPro although I have not checked this.

First, Foxplus does not use the DOS APPEND path to find files, and so the full pathname must be entered to open files which are not in the current directory (this is different from dBASE III which does use the APPEND path).

Second, Foxplus always adds a carriage return to every line feed sent to the printer, whereas dBASE III does not. This problem can affect in-line sub- or super-scripting.

Third, READKEY() returns a value of 271 when exiting from a READ with Ctrl-W or Ctrl-End. This value is returned whether or not there have been changes to the data (this bug is the same as in dBASE III). An explicit check has to be made to find out if any data has been changed.

A G Lloyd
Farnborough

Dear Mr Schifreen,

Further to your editorial in February's .EXE Magazine, there are three fundamental reasons why there still is not a computer terminal in every home. These are:

1. Large consumer-oriented databases would provide a higher level of service and convenience to the customer. This is to be avoided at all costs.

2. Installation of such equipment and development of the software represents an investment in the future and offers no short term high gain on low-level capital costs. This is to be avoided at all costs.

3. The general public might get ideas about improvements in other areas, like freedom of speech, justice for all and not just the rich, monopolies, abolition of the House of Lords etc.

So long as industry and commerce regard the consumer as a passing nuisance to be parted from his money as quickly as possible, and then got rid of, this situation will continue.

Chris Lawton
Bracknell

Dear .EXE,

I thought you might like to know that .EXE has done something newsworthy itself. With the February 1990 issue you gave away a booklet called 'The Software Training Guide'. As I leafed through this, I counted the courses on various different subjects. It occurred to me that the spread and choice of courses that training companies offer is a good barometer of where the computer industry is going. Using such information gives an indirect survey which should be much less prone to 'political' pressures than just asking people about their future spending plans up front.

I have fully analysed the number of courses on offer in the various areas. These figures take no account of the number of people trained by each course, but the samples are sufficiently large for this to even out and not be significant in comparing the subject areas against each other.

Top of the league is the expected 4GL and Database category. Not surprising, as databases are the single most important use that most companies have for computers. This has 22.1% of the market for training courses. Interestingly, about half of the courses offered are for UNIX related databases like Oracle and Informix. PC database products are a minority interest within the group, with only one third of the courses being for products like dBASE and Paradox. The rest of the courses could not be pinned down from title alone.

The next category is Systems and Software Design, with 15% of the courses. This is a very varied area, dealing with core methods of being a programmer as well as examining specific products such as CASE systems.

Courses specifically about UNIX and Xenix are next, with a 13.9% market share, followed closely by courses on Networking (both UNIX and non-UNIX) with a 10.3% share. Going on with the UNIX theme, C is the most popular language being taught, with 7.8% of all computer courses being C training ones. The next most popular language is COBOL, with a mere 2.1% of the market. COBOL may reign supreme in terms of numbers of existing programmers, but at this rate of training, C will catch it up. Maybe COBOLers are all trained in-house.

The MS-DOS and OS/2 operating systems are bundled together and can manage just 7% of the courses between them. This, however, is better than IBM Mainframes and Mini OS training - that has a 6.2% share.

If a poll of what people are learning reflects what they will soon be buying, then it looks like UNIX and LANs will be the dominant technology of the 90s. IBM mainframe and mini proprietary systems don't inspire much interest any more, and the number of people bothering to run OS/2 courses is pitiful, with just 120 courses organised compared to the 708 UNIX and Xenix ones.

I hope that my research gives food for thought. It certainly throws strong doubts on the eventual success of OS/2, that IBM and Microsoft insist will come but which nobody else believes. One thing that must be remembered about these figures is that they are for paid courses. The poor showing in some areas, such as general MS-DOS training, probably reflect a lack of demand for formal training because of the low value of the product. The fact that UNIX has a large number of training courses must mean that it still has a high perceived value in the eyes of the users, ie it is worth training people to get the most out of it.

Martin Houston
Houston Technology Limited
Birmingham

Dear Robert,

Although MS-DOS has facilities for redirecting input and output to other devices, it lacks a way of redirecting screen output to a file. All word processing programs have a 'print to disk' option. Is there an easy way of adding this capability to MS-DOS in general? The reason I ask is that there is a program whose (text mode) screen display I wish to capture to a file.

Peter Warren
London

Robert Schifreen replies:

There's a shareware program called LPTX, which does exactly what you require. This utility sits on the BIOS timer and video interrupts, and copies all video output to a file. MS-DOS does not normally approve of programs performing background file operations during the execution of another program, so LPTX has to use some clever trickery and a lot of undocumented DOS calls in order to achieve what it does. Although the author of the program goes to great lengths to point out situations where LPTX may fail, I recently used it in a programming project and it worked flawlessly.

You can get the program, complete with assembly langauge source code, from your local bulletin board or shareware library. Suggested registration fee, if you obtain the program and decide to use it, is $25.

.EXE

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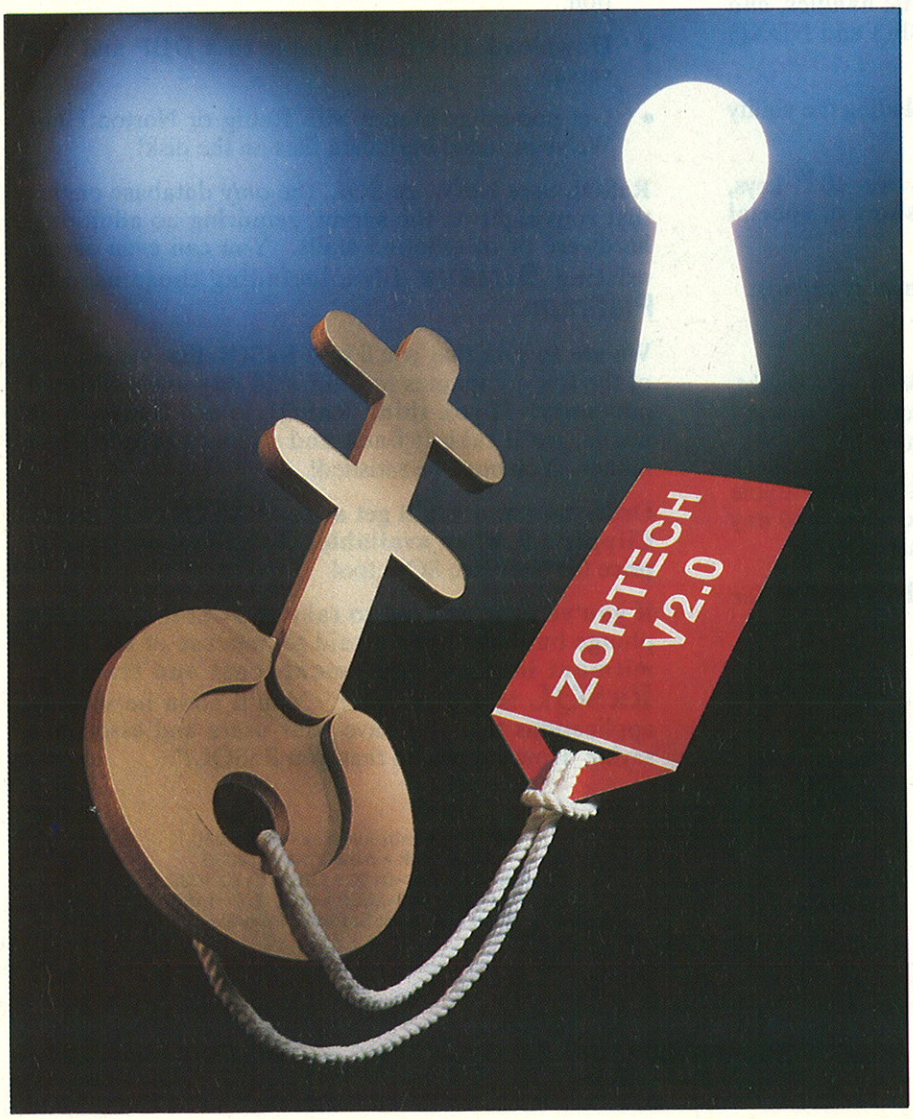
The Key to Success?

Release 2.0 of AT&T C++ compiler shipped on June 30th 1989. Less than four months later, Zortech became the first company to ship a C++ V2.0 compiler for MS-DOS. Paul Smith has been looking at Zortech C++ V 2.06.

Zortech was founded (as 'Zorland'), in 1986, to market an American C compiler called 'Datalight C'. The company was not ble for its aggressive pricing policy and its cheeky marketing approach (the company's original name was an undisguised swipe at Borland, who had carved out a massive market for their Pascal compiler using similar techniques). The British company was more successful than the C compiler's American distributors and, in 1987, was able to secure the rights to the product. An American office was opened. Walter Bright, the compiler's author, became a shareholder and the company changed its name to Zortech. The development of Zortech C++ began: version 1.0 shipped in 1988.



Zortech C++ was the first native code C++ compiler for MS-DOS. It has been extremely successful, and a significant proportion of C++ programmers around the world use it. The product is the market-leading C++ compiler for MS-DOS computers. When Zortech C++ 1.0 shipped, version 1.2 of the AT&T specification for C++ was current. Bjarne Stroustrup and his colleagues at AT&T were working hard on version 2.0 of the language at the time. Zortech continued improving their C++ compiler, working towards the current C++ version 2.0 compatible release.

The development of the compiler took place largely in the United States, under the control of Walter Bright. Most of the libraries, and the integrated environment, were developed in the UK.

The most significant facility offered by the current release of Zortech C++ is that it can be used to develop Microsoft Windows programs. Object oriented programming is well suited to event-driven graphical environments such as Windows: I have used object oriented programming techniques for some years to program the Macintosh, and have been waiting for a tool that will allow me to use them for Windows programming. Zortech C++ version 2.0 offers what I have been waiting for. Unfortunately, early releases have had problems that stopped it being used to build Windows programs. However, these problems were fixed by the release of version 2.06, which is the version reviewed here.

Installation

The package works with any IBM PC compatible computer running version 2.11 or

later of MS-DOS. It is actually a family of products tied together in an integrated working environment: the C++ compiler, editor and associated tools; a debugger; library sources and useful class libraries. These can be purchased individually, or together as a complete set called the 'C++ V2.0 Developer's Edition', which is what was used in this review. (Zortech also supplies an OS/2 Upgrade kit, but that is not covered here.) The package contains a thin installation guide, four perfect-bound A5 manuals (more on these later), and 11 5.25 inch diskettes.

Installation is easy. The installation program, ZTCSETUP, asks which parts of the package are to be installed, and lets you specify the directories that are to be used. The program even checks that there is enough space before proceeding. Thereafter, installation is simply a matter of inserting disks when asked.

I did find one peculiarity. ZTCSETUP started off by asking, abruptly, whether I required 'direct screen writes' - without explaining what it meant - in fact, it was asking whether screen output should go directly to the screen buffer or via the BIOS. Future versions of ZTCSETUP, says Zortech, will preface this question with an explanation. To be honest, I don't think it should be asked at all: BIOS screen writes should be used during the installation, as they will always be compatible and speed is hardly an issue.

The Programming System

Zortech supplies more than just a compiler for C++. They have endeavoured to include all the tools that one might need to develop and debug C++ applications. These tools can be used to form an integrated programming environment which they call, somewhat pretentiously, the Zortech Programming System.

Zortech have chosen to make the components of their integrated environment separate executable files, so that they can also be used from the DOS command line. This I found helpful, as I'm afraid that I don't feel at home with ZED.

The most significant facility offered by Zortech C++ is it can be used to develop Windows programs

ZED is a powerful multi-file, full-screen text editor, that also serves as the control centre for the integrated environment. One can conduct the entire program development/debugging cycle from within ZED, never seeing a DOS prompt. ZED allows up to five text files to be edited simultaneously. Switching between them is a matter of just two keystrokes. There is a separate configuration program which lets you reassign all ZED's editing keys as well as screen colours, default file and directory locations etc. See Figure 1 for a picture of ZED at work.

To build your program from within ZED, you simply press F9, followed by any compiler flags that are required. ZED will then launch the compiler and, if your program compiled successfully, run the Zortech linker to make it into an executable file. You can then test run your program, by pressing Enter in response to the next prompt, or ESCape back to the editor.

If the compiler finds an error, it will highlight the problem in the editor and invite you to correct it. Even though different sub-programs must be loaded for each stage of this process, the Zortech system is impressively fast.

Multi-module programs can also be built from within ZED, by using the full-featured Zortech MAKE utility. A further utility, MAKEDEP (MAKE DEPendency list), is provided to simplify the construction of MAKE files.

The editor has a few bugs, although none is serious. For instance, if you ask it to delete a line when the cursor is part way along that line, part of a line further down the screen will be zapped as well. Once, using ZED with a mouse - it is mouse compatible - it froze up completely, the cursor flashing wildly. Such problems as there are can be avoided fairly easily, and will presumably be picked up and fixed by Zortech in future releases.

My real complaint about ZED is the user interface. ZED tries, and in my view fails, to offer an SAA/CUA conformant user interface in the style of Presentation Manager and Windows 3. ZED's style of operation is inconsistent, and it just is not sufficiently forgiving of operator errors. For instance, it is too easy to delete text accidentally when copying between files. Unless one notices

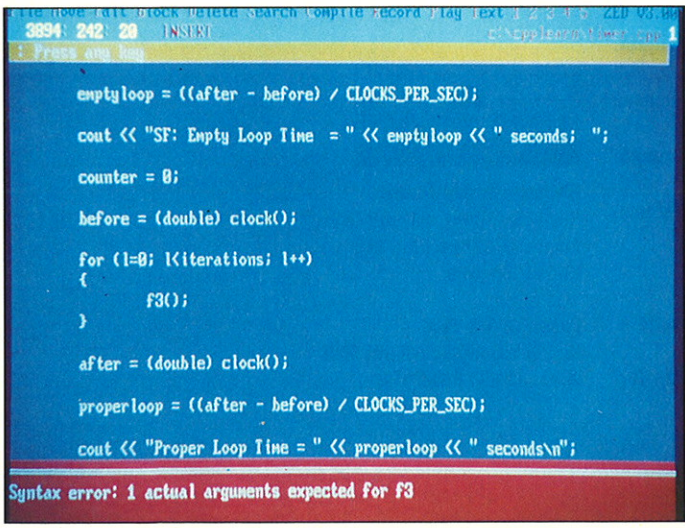


Figure 1 - the Zortech Editor

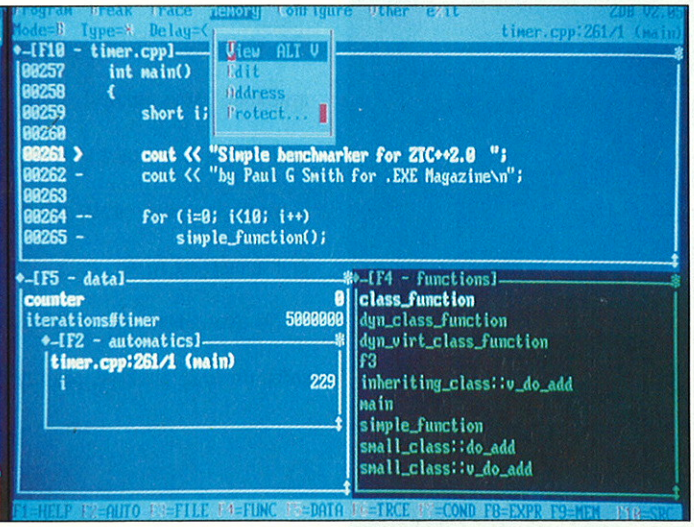
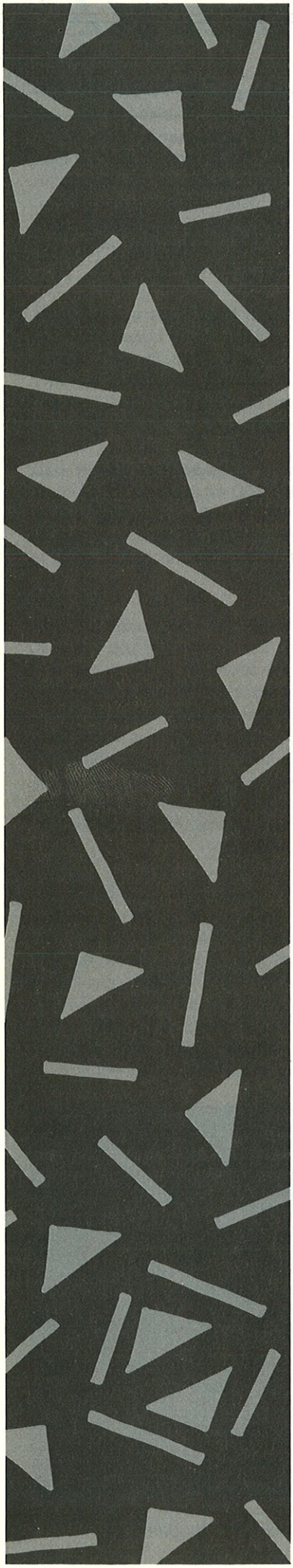


Figure 2 - the Zortech Debugger



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and restores it at once, that text is lost. The user interfaces of the various tools (Editor, Configuration program, and Debugger) are also inconsistent with each other. The differences jar. I am too used to Macintosh and Windows-style user interfaces to be happy with a botch like this - I would rather use a simpler editor like PE2 or Brief. This style of integrated environment is a great step forward, but it must be done right. I look forward to further great steps forward in future releases of ZED.

Another part of the Zortech environment is a TSR pop-up program called `ZTCHELP`. Typically installed from `AUTOEXEC.BAT`, you call it up with a simple hot-key combination. `ZTCHELP` works both inside and outside Zortech's Programming System, providing on-line help on the C++ language and standard library functions. `ZTCHELP` pops up displaying an index of all the help entries in its database: it guesses the correct entry by looking at the word under the cursor. The results of this can be amusing if this word is not in its index. Once inside `ZTCHELP`, it is easy to cursor to the entry of interest; pressing Enter will then display the relevant screen. On my system, `ZTCHELP` uses up 43.5 KB of DOS memory.

The Compiler

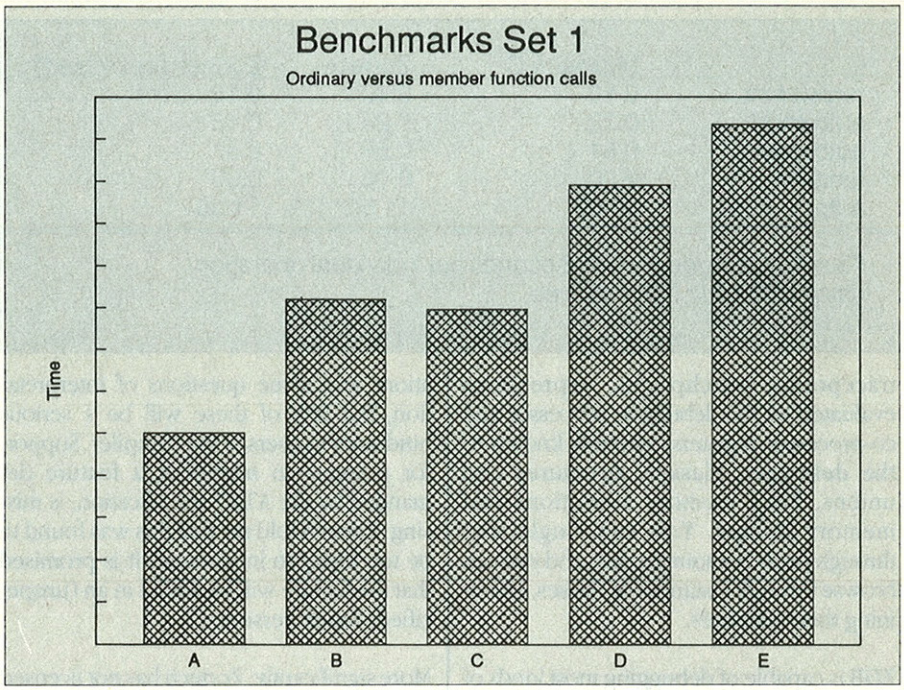
Zortech's compiler control program ZTC is, like Microsoft's similar CL, responsible for controlling all the passes of the compilation and linking process. It is even able to invoke MASM for assembler source files.

ZTC controls a two-pass compilation system, with an optional global optimisation pass. The first pass handles pre-processing, syntax checking, and the generation of compressed intermediate code.

There are three different tools supplied to perform the first pass: one for C++ source files, and two for C source files (one which can handle larger programs, but slower).

The global optimiser module, ZTG, takes the output from the first pass and, one function at a time, performs data flow analysis on it. It then applies various optimisation techniques: constant and copy propagation; common subexpression, dead assignment, dead code, and dead variable elimination; loop invariant removal and loop induction variable replacement (which extracts calculations from the body of loops and replaces them with simpler arithmetic). ZTG slows the overall compilation process significantly, and it is prudent to use it only when you have your program debugged and operational.

Figure 3 - Function call benchmarks



The second compiler pass, working on half-digested code which may or may not have been run through the global optimiser, is an 8086 code generator. Once again there are two versions, one of which is capable of dealing with much larger programs at the expense of a longer compilation time.

In all tests but one, Zortech C++ produced faster code than Microsoft C V5.1

Zortech C++ includes a C compiler. As you might have noticed from my description of the first pass, the package is capable of compiling plain vanilla C source files as well as C++. Your programming projects can be truly cosmopolitan, with C++, C *and* MASM source files. There are the usual option switches to control compiler operation, such as forcing ANSI compatibility for C programs.

The C++ compiler issues too few warnings, especially when compared to the benchmark implementation: AT&T's Cfront. For instance, one short program that I compiled contained several errors typical of a C programmer writing C++, eg functions with no `return` statement not declared `void`, and careless inefficiencies such as unused local variables. Cfront picked up all of these. The Zortech C++ compiler let them all through without a murmur.

BLINK, the linker, is compatible with a large subset of the standard Microsoft LINK's functions, but it does not support overlays, and differs in some small operational details. Its output is not compatible with MS-DOS's EXE2BIN utility (because BLINK packs program header information differently), so Zortech supplies its own, for converting tiny memory model .EXE programs to .COM files. Five different memory models are supported, by the way: tiny, small, medium, compact, and large.

The Debugger

First, a damaging admission. My training as a programmer took place at a time when debugging meant looking at the source and trying to work out what went wrong. I can even remember being quite impressed when I came across MS-DOS's DEBUG for the first time. To someone with my background, Zortech's debugger, though one of many such tools available to today's programmers, is inevitably pretty good-looking. However, for this review I have tried to see it through the eyes of a cynical, hard-bitten CodeView regular.

There's no doubt that ZDB, Zortech's symbolic debugger, is powerful. It offers multi-window display of source files, stack parameters and variables, functions, external variables, trace records, breakpoints,

Figure 4 - Plum Hall C benchmarks

	Microsoft C	Zortech	Zortech (optimised)
register int	0.16	0.19	0.18
auto short	0.22	0.24	0.18
auto long	0.61	0.57	0.57
function	2.20	0.66	0.66
auto double	50.00	11.50	11.00

Results recorded in microseconds per individual operation, using a 33 MHz 386 machine.

tracepoints, watchpoints, expressions evaluated by the debugger, processor and co-processor registers, symbols known to the debugger, classes, structures and unions, heap memory allocations and memory dumps. You can single-step through your C++ source code, and you can browse through instances of classes, examining their members.

ZDB is capable of debugging most kinds of .EXE file, acting as a symbolic debugger if the information is available within the program file. ZTC has a command line switch that causes the compiler and linker to generate the necessary information; ZDB is also able to accept CodeView compatible symbolic information from other compilers. A tool called ZMAP, which is normally called automatically by ZDB the first time it debugs a program, converts and compresses symbolic information into a format suitable for ZDB.

Figure 2 shows ZDB in operation. There are menus, operated in the same way as ZED menus, and 'hot-keys' for important commands. A mouse can be used to initiate menu commands and control windows. You can have lots of windows open at once, each containing views of different debugging information. It is easy to switch between them - as long as you don't have too many open. If I might venture a suggestion, a 'windows' menu could make navigation between different overlapping windows easier.

If you like, you can use CodeView instead of ZDB, although you will lose the ability to examine class instances and mangled function names (produced by the compiler to ensure type-safe linking) will not be decoded.

Compatibility

Zortech C++ version 2.0 achieves a high degree of compatibility with the AT&T version 2.0 specification. Additionally, the C compiler is largely compatible with the ANSI standard for C. There are a few deviations and some questions of interpretation, but few of these will be a serious hindrance to users of the compiler. Support for pointers to members, a feature demanded by the AT&T specification, is missing. Zortech told me that this was found to be too tricky to implement. It is promised that the feature will be added in an (unspecified) future version.

More significantly, Zortech has not licensed the AT&T C++ version 2.0 standard libraries, which means that there are some omissions from the library support. The Streams input/output library is the old, version 1.2, design. Version 2.0 of C++ introduced a new version of Streams, but Zortech users cannot make use of it. This is analogous to a C compiler without `fprintf()` in STDIO.H. Perhaps I exaggerate a little, but it's certainly the sort of omission that people porting code to Zortech C++ don't need, and it may confuse new users. Zortech says that it is considering the possibility of licensing Streams 2.0 from AT&T. Also missing are the complex number and task management libraries. There is a public domain version of the complex numbers library on the Zortech bulletin board, so perhaps they should consider including it as standard with the compiler.

Zortech C and C++ are not totally Microsoft C compatible: code ported from Microsoft C may require changes. I found that small sample Microsoft programs ported across to Zortech C fairly painlessly. The most important thing to remember is that C++ and C are not the same language. Microsoft C programs will generally compile with the C compiler provided in the package. Zortech's C purports to be more ANSI-compatible than Microsoft's. I was not able to prove or disprove this.

At the implementation level, Zortech does not support the huge memory model, the `huge` pointer type or the `interrupt` function type (it provides a library of interrupt management functions instead). You shouldn't try to link Microsoft C .OBJ files with .OBJ files produced by this package. Differences in the STDIO.H `_iob` structure means that Microsoft .OBJ files can't link with the Zortech libraries, and vice versa. Likewise, the floating point libraries differ. Zortech's floating point library is not totally IEEE compatible, but it intends to release an IEEE compatible version in the future.

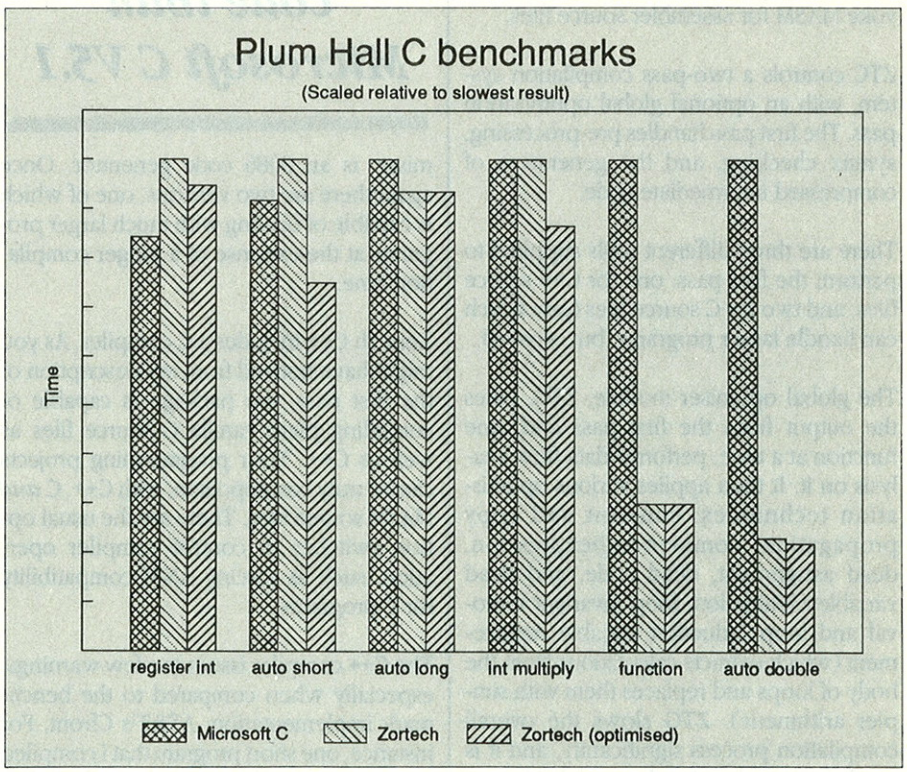


Figure 5 - Graph of Plum Hall C benchmarks

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CIRCLE NO. 788

I used the C compiler provided with Zortech C++ to build three small Windows applications. (You need the Microsoft Windows Toolkit to do this. Windows compatibility is achieved via the toolkit header files, and because the Windows system does not use floating point arithmetic). I went on to experiment with building C++ classes for Windows but, because of time constraints, I did not get very far. Having had experience of object-oriented applications development frameworks like MacApp, I missed having a standard set of Windows classes that I could pick up and build upon. Windows developers wanting to make full use of the power of C++, will find themselves building their own classes, re-inventing the wheel over and over again, until something like CommonView becomes available for Zortech.

Tools and Source Libraries

The function libraries include the standard C++ and C libraries, BIOS interface, fast text screen library, DOS interface, extended memory and EMS handle managers, interrupt handler library, mouse control library, dynamic heap page manager, sound library and a TSR library, which will be particularly useful to programmers who need to develop pop-up memory resident programs.

There is also a wide selection of C++ classes. However, these do not constitute an applications program development framework like ET++, CommonView, or MacApp; all the classes are low-level, although useful, components and do not make up a complete class library. Perhaps the best way to think of them is as a set of *sample* C++ classes: some you might use unchanged, others serve as models for your own code.

Classes supplied include: bit vectors, singly and doubly linked lists, dynamic and virtual arrays, binary trees, hash tables, BCD arithmetic, time and date handling, a real-time clock display, directory and filename handlers, DOS error handler, string editing, text windows, text editing, monetary arithmetic and event queue management.

Documentation

The manuals are themselves good. There are four volumes, plus an installation booklet. The Compiler Reference defines the C++ language, the compiler, the linker and the editor, and explains the operation of the Zortech Programming System. The Function Reference lists all the libraries and their functions alphabetically. It contains a combined index for both itself and the Compiler Reference which, once I got over my initial confusion, I found to be a sensible arrangement. The Tools manual describes all the C++ classes, and the Debugger manual provides a tutorial and reference to the ZDB debugger.

Zortech does not offer Streams V2.0. This is analogous to a C compiler without fprintf() in STDIO.H

Although the Compiler Reference contains a tutorial style introduction to C++, I think that beginners will need a separate book, such as Stanley Lippman's *C++ Primer*, and should look to the Zortech manual as reference only. Zortech provides the usual READ.ME text file on one of the Compiler diskettes, with a summary of known bugs and pitfalls.

Benchmarks

No review of a compiler is complete without a set of benchmarks. I have run two separate sets of tests on Zortech C++. The first compares the relative efficiencies of ordinary and class member function calls - in effect, it measures the overhead of 'object orientedness'. The second is a comparison of Microsoft C version 5.1 against Zortech C++ version 2.0.

The first set of benchmarks, illustrated in Figure 3, compares a simple call to a simple parameterless void function (labelled 'A' in the diagram) with, respectively, a similar static member function of a stack-allocated class ('B'), a static member function of a heap-allocated class ('C'), a virtual member function of a stack-allocated class ('D') and a virtual member function of a heap-allocated class ('E'). Not unexpectedly, a simple function call is about one and a half times as fast as a non-virtual member function call, and a virtual function call, which involves a lot of extra dereferencing takes about twice as long as a simple function call.

The second set of benchmarks, shown in Figures 4 and 5, are the Plum Hall public domain C benchmarks, provided courtesy of the BSI. Although these benchmarks are written in standard C, the Zortech compiler uses the same code generator and optimiser for C as it does for C++, so this is a fair test.

These tests compare register int, automatic short, automatic long, integer multiply, function call, and automatic double operations. I ran the benchmarks twice for Zortech C: once with optimisation disabled, and once through the global optimiser. In all tests but the first, Zortech C produced faster code than Microsoft C version 5.1.

Conclusion

There can be little dispute that version 2.0 of the C++ Standard is an important landmark in computer language technology. If you want to be using C++ at this level, and you are working in MS-DOS, then you have a choice of just one when looking for machine-code producing compilers.

But that's taking a rather negative point of view. The Zortech compiler is a well-crafted product; in particular it is efficiently documented and it produces high quality object code. I can recommend it as a fine package for learning C++.

There are problems, though. If you are building very large applications, you may miss explicit support for overlays; you may also find, like me, that the editor and debugger have their rough edges. On balance, these are small gripes. It's a very mature product for such a young company, and I rate it.

.EXE

Paul G Smith is a free-lance software development consultant and technical writer specialising in graphics, communications and the application of object-oriented programming techniques. He can be contacted on CIX as 'pgsmith', and on AppleLink as UK0310.

Product Details

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*Written by Neil Martin of the British Standards Institution (BSI) and printed in Personal Computer World June 1989, page 241.

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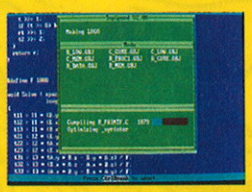

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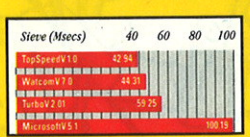

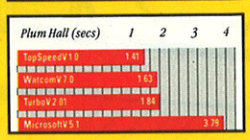

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Benchmarks measured by Mark Hamilton, November 24, 1989. Copyright © 1989, PC Business World and CW Communications Ltd.

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CIRCLE NO. 789

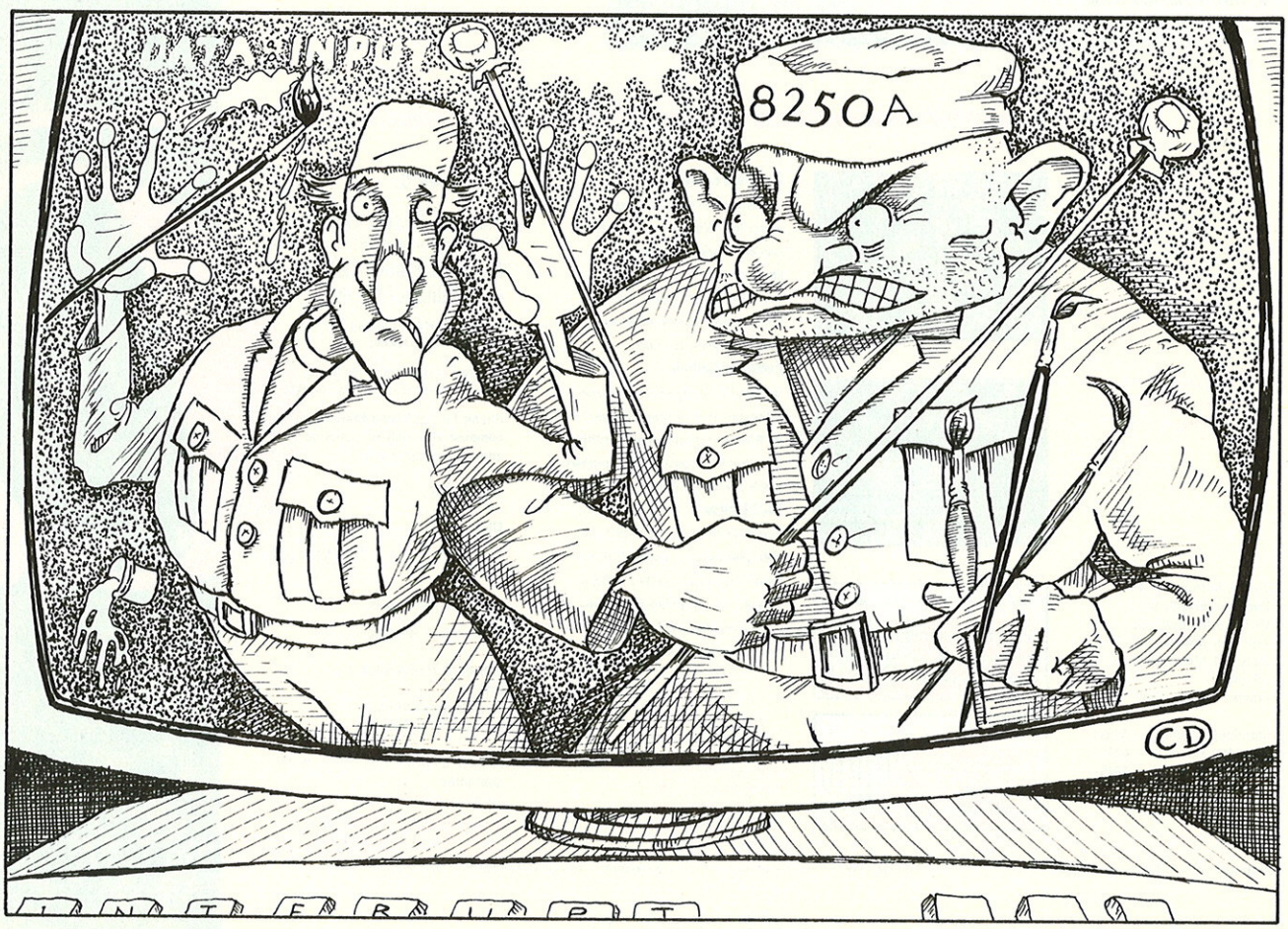
If I may interrupt?

When Andrew Margolis wrote about PC UARTs, we received several letters asking: why didn't we invite him to write about interrupt-driven serial communications? So we did, and he has.

Communications, involves events which occur outside your machine. These events are beyond your control. If you don't react to them properly then communication will break down. Interrupt routines are so useful because, once you've set them up properly, you can forget about these goings-on (not to mention bit twiddling serial ports and convoluted communication protocols) and concentrate on the creative stuff. Because an interrupt system lies outside normal program execution, it can grab control and respond to external events *as they occur*. When the job is done, control is restored to the application without it ever knowing what has been going on.

To write an interrupt routine, you must program the hardware at the lowest level. This doesn't mean that it is difficult, but you will need the right software tools for the job. In some languages it is not possible to write an interrupt handler, in others it is merely difficult. Even C, which has rather good facilities for writing operating systems and programming hardware, is not ideal for interrupt handlers. For one thing, it has no facilities for handling binary numbers at source level: very inconvenient in a field that makes so much use of bit masks. Another problem, applicable to all high-level languages, is that you really do need to know exactly what object code your compiler produces, so that any critical sections can be protected.

Consequently, all the best interrupt handlers are written in assembly language. Only in assembly language can the code be fully optimised for speed - interrupt handlers can never afford to hang around. Writing in assembler is the easiest way to guarantee self-sufficiency, for there are going to be no concealed calls to non re-entrant language libraries or operating system services. The usual arguments raised against programming in an assembly language (lack of portability, needing to know how the CPU works, having to write all the utility code



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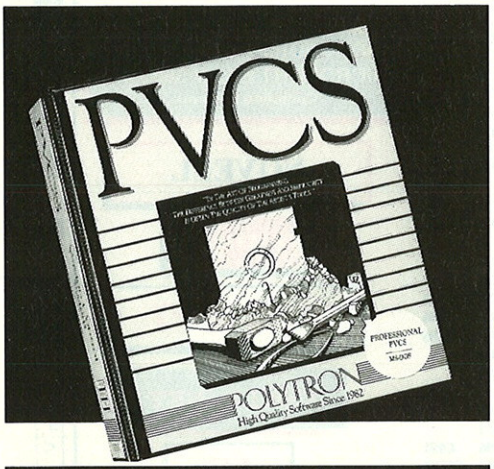

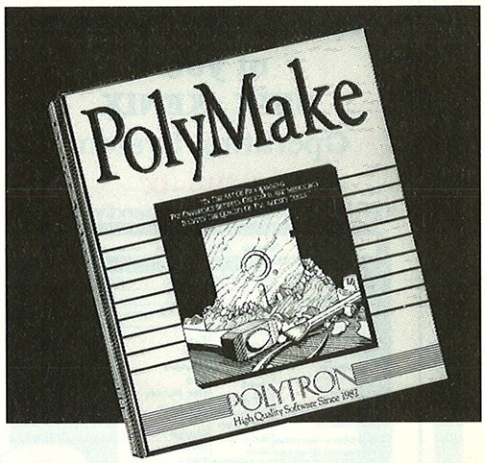

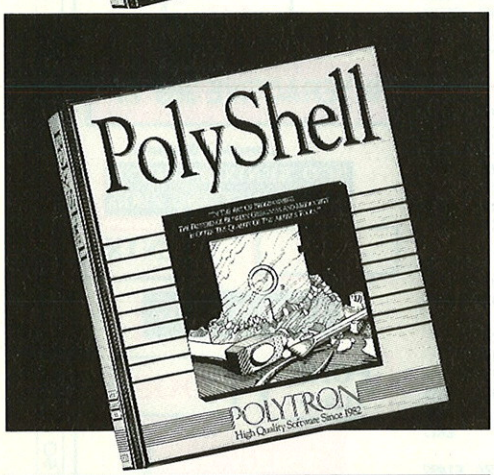

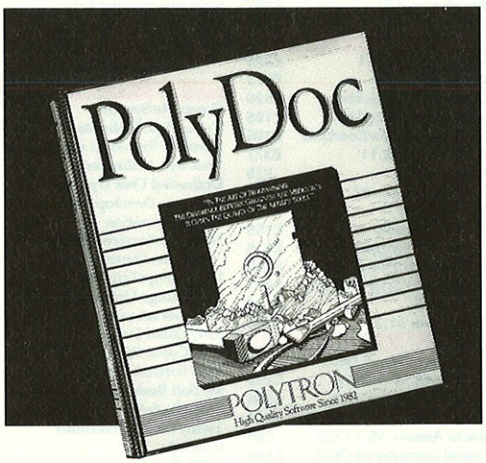

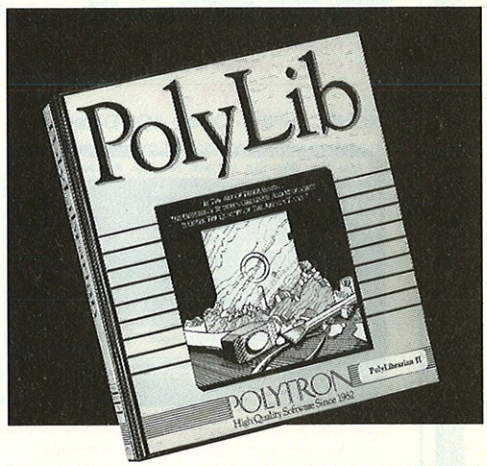

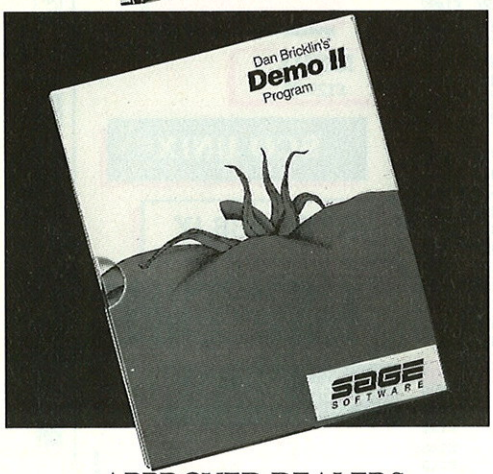

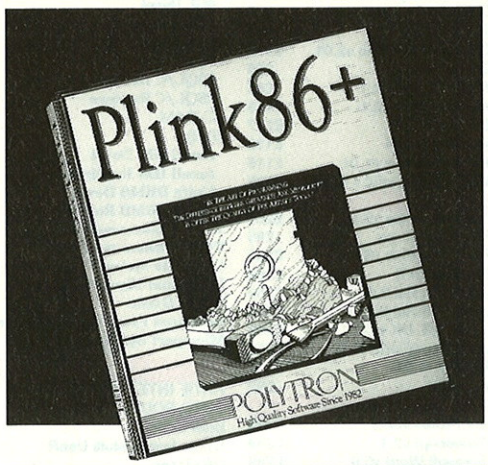

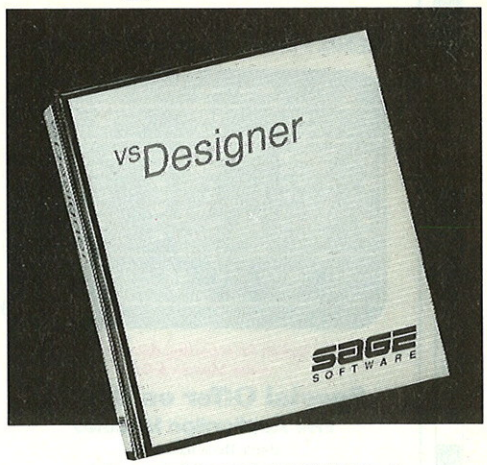

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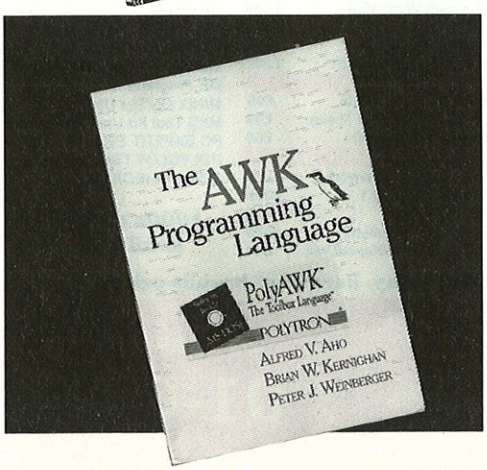

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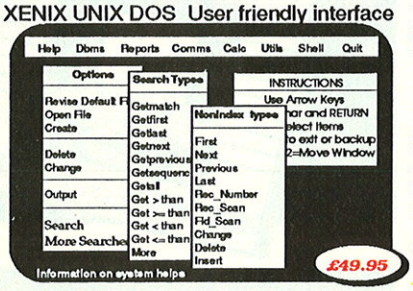

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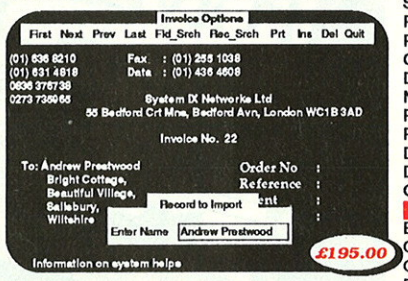

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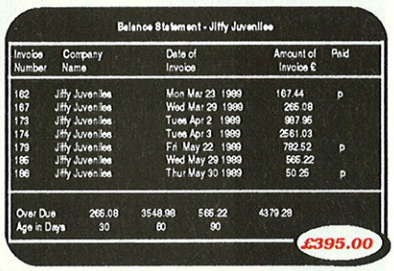

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Figure 1 - Sample Program

```
;****************************************
;
;
;
; Simple interrupt-driven terminal program
; Language : Borland Turbo Assembler
;
; Copyright (c) Andrew Margolis 1990
;
;
;
****************************************
;
;
;
.model tiny
.code
;
  org  100h    ; a .COM file
start:
  call vectors ; set up our irq
  call intson  ; and enable interrupts
;
keypoll:
  mov ah,6     ; direct input
  mov dl,0ffh  ; with dl=0ffh
  int 21h      ; done
  jz  pollport; if nothing, check port
;
  cmp al,3     ; control-c
  jz  exit     ; out
  call send    ; else send
  jnz pollport; sent if nz
;
  mov ah,2  ; no, sound
  mov dl,7  ; bell
  int 21h   ; via dos
pollport:
  call read   ; any characters ?
  jz  keypoll ; loop if none
  mov dl,al   ; else char in dl
  mov ah,6    ; direct output
  int 21h     ; done
  jmp keypoll ; loop
;
exit:
  xor al,al     ; zero to ier
  mov dx,ierreg
  out dx,al     ; disables UART ints
;
  mov dx,oldint
  mov ds,oldint+2
  mov ah,25h
  mov al,comint
  int 21h   ; this restores old vector
;
  push cs
  pop ds
  int 20h   ; back to dos
;
;
;****************************************
;
;
; now the data area
;
nextin  dw  1 dup (?)
nextout dw  1 dup (?)
;
charin  dw  1 dup (?)
charout dw  1 dup (?)
;
flowin  db  1 dup (?)
flowout db  1 dup (?)
;
inbuf   db  2048 dup (?)
outbuf  db  256 dup (?)
;
comint  equ  0ch       ; com1 is int 0ch
ourmask equ  11101111b ; mask enables irq4
dataport equ  03f8h    ; base of com1
;
ierreg  equ  dataport+1
iirreg  equ  dataport+2
wordef  equ  dataport+3
modcont equ  dataport+4
statport equ  dataport+5
modstat equ  dataport+6
;
; jump table for interrupt service
;
intab dw  modint ; modem status
    dw  txint    ; transmitter empty
    dw  rxint    ; receive character
    dw  exint    ; external status
;
oldint dw  2 dup (?) ; old vector saved
;
;
;****************************************
;
;
; now the more useful subroutines
;
;
;****************************************
;
;
; getting old, setting new, interrupts
;
vectors:
  mov  ah,35h       ; get vector
  mov  al,comint    ; for irq we use
  int  21h          ; to es:bx please
  mov  oldint,bx    ; save address
  mov  oldint+2,es  ; and segment
;
  mov  dx,offset service ;ds:dx to our isr
  mov  ah,25h     ; set vector
  mov  al,comint  ; for irq we use
  int  21h        ; to es:bx please
```

yourself) are actually requirements for the task in hand.

The first step, then, is to choose your assembler. Next, you must obtain technical information on the hardware. This is found on the manufacturer's specification sheets, in the case of specific chips being programmed, and your computer's technical manuals for port addresses and other machine-specific information. This article is about interrupt handlers for UARTs (Universal Asynchronous Receiver Transmitters) on PCs, so you will find details of the UART registers in Figure 2 and some useful IBM addresses in Figure 3. Figure 1 contains fully working code for a simple interrupt-driven terminal program, and I will use it to illustrate most of the techniques discussed. *(This code is available for downloading from the EXE conference on Cix - Ed.)*

Installation and activation

Interrupt handler code must be installed and activated before it can be used. The installation and activation phases are quite separate from the interrupt routines themselves, so to keep things clear, I will describe these prerequisites first.

The mechanics of installation are straightforward. The MS-DOS Int 21h group of system services includes function 25h, which sets the vector for the interrupt number passed in AL to the segment:offset address passed in DS:DX. If you want to be able to remove your interrupt handler (chances are that you do), or are using a shared interrupt line and need to chain interrupts, then you will also need to save the original interrupt vector before installing your own. MS-DOS function 35H enables you to do this, returning the current vector address in ES:BX of the interrupt number passed in AL. The subroutine `vectors` in Figure 1 contains some code for getting and setting interrupt vectors in this way.

Activation is a three-stage process. First, the interrupt enable register on the UART has to be set to enable only the type of interrupts you are going to service. Second, you need to set a signal called OUT2,via bit 3 in the modem control register: this is a peculiarity of IBM PC hardware. Lastly, you must program the 8259 PIC (Programmable Interrupt Controller) interrupt mask register on the PC to enable interrupts for the specific IRQ (Interrupt Re-Quest) line you want. Each bit of an 8-bit word sent to the high r/w port of the PIC enables the corresponding IRQ line if 0, or disables it if a 1. As with setting interrupt vectors, the previous contents of these registers must be saved if you are to remove your interrupt handler later.

One thing that puzzles some people is that COM1 uses IRQ line **4** but generates interrupt **12** (0CH). The reason for this is quite simple. There are eight hardware IRQ lines

	Base	Base	+1	+2	+2	+3	+4	+5	+6	+7
	RX Data DLAB=0	TX Data DLAB=0	Interrup Enable	Interrup Identity	FIFO Control	Line Control	Modem Control	Line Status	Modem Status	Scratch Reg
BIT	R/O	W/O	R/W	R/O	W/O	R/W	R/W	R/W	R/W	R/W
0	Data 0	Data 0	Receive Data Ready	0 when interrup pending	FIFO Enable	Word Length Bit 0	DTR	Receive Data Ready	Delta CTS	
1	Data 1	Data 1	Transmit Hold Reg Empty	Interrup ID Bit 0	RX FIFO Reset	Word Length Bit 1	RTS	Overrun Error	Delta DSR	
2	Data 2	Data 2	Receive Line Status	Interrup ID Bit 1	TX FIFO Reset	Stop Bits	Out 1	Parity Error	Trailing Edge RI	
3	Data 3	Data 3	Modem Status	16550 ONLY Bit 2	DMA Mode Select	Parity Enable	Out 2 IBM Intr En	Framing Error	Delta DCD	
4	Data 4	Data 4	0	0	Reserved	Even Parity	Loop	Break Detect	CTS Status	
5	Data 5	Data 5	0	0	Reserved	Stick Parity	0	Transmit Hold Reg Empty	DSR Status	
6	Data 6	Data 6	0	16550 FIFO Enabled	RX Trigger LSB	Break Set	0	Transmit Shift Empty	RI Status	
7	Data 7	Data 7	0	16550 FIFO Enabled	RX Trigger MSB	DLAB	0	16550 RX FIFO Error	DCD Status	
		R/W	R/W							
		DLAB=1 Divisor LSB	DLAB=1 Divisor MSB							

Note: NatSemi recommends that the line Status Register NOT be written to, as this is only supposed to be done in factory testing. The only 8250A/16450 bits that change in 16550 FIFO mode are bits 3, 6 and 7 in the interrupt identification register and bit 7 in the line status register.

Figure 2 - UART registers

```
;
;
;****************************************
;
;
; activating interrupts
;
;
intson:
   xor   ax,ax          ; zero pointers
   mov   nextin,ax
   mov   nextout,ax
   mov   charin,ax
   mov   charout,ax
;
   in    al,21h         ; read PIC mask
   and   al,ourmask     ; set our IRQ
   out   21h,al
;
   mov   dx,modcont     ;modem control
   mov   al,00001011b ;dtr rts and out2 on
   mov   flowin,al      ; input flow control
   out   dx,al
;
   mov   dx,modstat     ;modem status
   in    al,dx          ;read it
   and   al,00010000b ;isolate cts
   mov   flowout,al     ;output flow control
;
   mov   dx,ierreg      ;int enable reg
   mov   al,00001111b ;enable all
   out   dx,al
;
   sti                  ; int enable
   ret
;
;
;
;****************************************
;
;
; interrupt service routine
;
;
;****************************************
;
;
;
service:
   push  ds
   push  ax
   push  bx
   push  dx
   push  si
;
   push  cs
   pop   ds             ; use code as data
seg
;
again:
   mov   dx,iirreg      ; interrupt id reg-
ister
   in    al,dx          ; read
   test  al,00000001b ; if nothing pend-
ing = 1
   jnz   endserv        ; out
;
   mov   bx,offset intab ; jump table
   xor   ah,ah          ; zero ah
   and   al,00000111b   ;if 16550 in use
   add   bx,ax          ; add offset
   call  word ptr [bx]  ; call isr
   jmp   again          ; and loop again
;
endserv:
   mov   al,20h         ; end-of-interrupt
   out   20h,al         ; send it to pic
;
   pop   si
   pop   dx
   pop   bx
   pop   ax
   pop   ds
   iret     ;return to interrupted process
;
;
;
;****************************************
;
;
;
; rx interrupt - reads and saves data
; in 2048 byte circular input buffer
;
;
;
rxint:
   mov   dx,dataport ; data port
   in    al,dx          ; read data
;
   mov   si,nextin
   mov   bx,offset inbuf
   mov   [bx+si],al   ; save data
   inc   nextin
   and   nextin,07ffh; wraparound
;
rxpoll:
   mov   dx,statport ; any more ?
   in    al,dx
   test  al,00000001b
   jnz   rxint          ; yes, read it
;
   test  flowin,00000010b
   jz    jusret         ; if rts already off
   sub   si,nextout   ; work out bytes used
   and   si,07ffh     ; wraparound
   cmp   si,0600h     ; 3/4 full ?
   jb    jusret       ; no
   mov   dx,modcont   ; modem control
   mov   al,00001001b; rts off
   mov   flowin,al    ; save rts state
   out   dx,al
   ret
```

Figure 3 - Useful IBM addresses

8259 Programmable Interrupt Controller (PIC)	
Port 20h Port 21h	write 20h as an end-of-interrupt (EOI) read/write 8-bit interrupt mask bit 0 controls IRQ 0 -> bit 7 controls IRQ 7 1=masked 0=enabled

8250/16450/16550 Universal Asynchronous Receiver/Transmitter (UART)				
	Base port	IRQ line	Interrupt number	Vector address
COM1	03F8H	IRQ4	Interrupt 0CH	0000:0030H
COM2	02F8H	IRQ3	Interrupt 0BH	0000:002CH

altogether, which go to the CPU via the interrupt controller. The CPU can handle up to 256 logically different software interrupts. The hardware IRQ lines are mapped on to eight of these. However, since interrupts 0 through to 7 are mostly reserved for the CPU itself (for instance, interrupt 0 is generated whenever a divide-by-zero is attempted), the hardware interrupts must live somewhere else. On the IBM PC, they are mapped onto interrupt 8 upwards; thus COM2's IRQ3 generates interrupt 11 (0BH), COM1's IRQ4 generates interrupt 12 (0CH) and so on. The addresses (vectors) of all the interrupt routines are held in a table starting at the bottom of memory.

One final step is to make sure that the interrupt flag of the CPU itself is set. Usually this is unnecessary, as this is its normal state, but is is a point worth making. If, for some reason, you have cleared this flag, then interrupts are *never* acknowledged by the CPU. Indeed, if any one of the above items is omitted or done wrong then, however tightly your interrupt handler is written, it may never get a chance to work. The subroutine `intson` shows sample code for enabling an interrupt service routine. (It also initialises flow control flags, but I will come to that later.)

Before dealing with the nitty-gritty of interrupts themselves, a few words about the 'application' program in the Figure 1 example. The `keypoll` loop, which is ended when the operator presses Ctrl-C, is a noddy program to demonstrate the interrupt handlers and associated code. The loop prints incoming characters to the screen; while keystrokes are echoed out to the serial port.

What the hardware does

Here is the sequence of events inside the PC hardware when an interrupt occurs. The UART raises a signal on its interrupt pin when an interruptable condition occurs (provided that the condition is enabled within its interrupt enable register). The circuitry on the serial card ANDs this with the OUT2 signal set by bit 3 in the modem control register (which is why it has to be set to activate an interrupt handler). If both are high, a signal is raised on the system bus to the IRQ line at the interrupt controller. If this IRQ line is enabled within the mask register on the PIC, the low-to-high transition will mean that the corresponding interrupt number is generated at the CPU. (By the way, this is known as an edge triggered interrupt).

The CPU now pushes its flags on top of the stack, disables further interrupts by clearing its interrupt flag, saves the contents of CS and IP on top of the stack and reloads CS:IP with the interrupt vector that it finds in the low-memory interrupt vector table.

At this point, our interrupt handler has been activated. From the point of view of the rest of the system, all we must do is end the interrupt condition at the CPU and restore the saved registers from the stack. The program that was executing before the interrupt will then carry on, as the CPU has been restored to its pre-interrupt state.

To end the interrupt condition at the CPU, one issues an EOI (end-of-interrupt) instruction to the PIC; conveniently, this is done by writing 20H to port 20H. The restoration of the flags and CS:IP is handled by one simple IRET return-from-interrupt instruction. Nearly all hardware interrupt handlers end in this way, in my example it appears after the `endserv` label.

If the simplest routine, consisting of just the five instructions required to issue EOI and return, was installed as an interrupt handler, it would be sufficient to keep the system running. Since such a routine does not find out what caused the interrupt, or attempt to service it, the interrupt line from the UART to the PIC would remain high. However,

```
;
;
;*****************************************
;
;
; removes character from input buffer
; returns z set or al=char and z clear
; alters : si ax bx dx
;
read:
   xor   ax,ax
   mov   si,nextout
   cmp   si,nextin    ; is buffer empty ?
   jz    jusret       ; yes, back z
;
   mov   bx,offset inbuf
   mov   al,[bx+si]   ; else get data
   inc   si
   and   si,07ffh     ; wraparound
   mov   nextout,si
;
   test  flowin,00000010b
   jnz   jusret       ; back nz if rts on
;
   mov   bx,nextin    ; offset to next free
   sub   bx,si        ; gives bytes used
   and   bx,07ffh     ; wraparound
   cmp   bx,0200h     ; getting empty ?
   jb    jusret       ; not yet, back nz
;
   mov   ah,al        ; save data
   mov   dx,modcont   ; modem control
   mov   al,00001011b; else rts on
   mov   flowin,al    ; save rts state
   out   dx,al
   mov   al,ah        ; restore data
   ret
;
;
;*****************************************
;
; tx interrupt here - send data from
; 256 byte circular output buffer
;
txint:
   cmp   flowout,0    ; if cts is off
   jz    jusret       ; don't send
   mov   si,charout
   cmp   si,charin    ; check if any data
   jz    jusret
   mov   bx,offset outbuf
   mov   dx,dataport ; data port
   mov   al,[bx+si]   ; get data
   out   dx,al        ; and send it
   inc   charout
   and   charout,00ffh ; wraparound
jusret:
   ret
;
;
;*****************************************
; places character in 256 byte
; output buffer if room, wakes up
; transmitter if buffer and transmitter
; holding register are both empty
; return nz if character queued ok
; else return z if queue full
; alters : si ax bx and dx
;
send:
   mov   ah,0ffh
   mov   si,charin
   mov   bx,si
   add   bl,2
   cmp   bx,charout     ; only one space ?
   jz    jusret         ; back z set if so
;
   mov   bx,offset outbuf
   mov   [bx+si],al
   inc   charin
   and   charin,00ffh
;
   cmp   si,charout     ; was buffer empty
?
   jnz   jusret         ; not empty, back
   mov   dx,statport    ; read line status
   in    al,dx          ; was transmit hold
   test  al,00100000b   ; register empty ?
   jz    txret          ; not empty, back
   call  txint
txret:
   xor   ah,ah
   ret
;
;
;*****************************************
;
; modem status interrupt
; used for flow control
;
modint:
   mov   dx,modstat    ; modem status
   in    al,dx         ; read it
   test  al,00000001b ; has cts changed ?
   jz    jusret        ; no, ignore
   and   al,00010000b ; isolate cts
   mov   flowout,al    ; save as flag
   jnz   txint       ;resume sending if on
   ret
;
;
;*****************************************
;
; line status interrupt
;
exint:
   mov   dx,statport
   in    al,dx ;clear by reading line
status
   ret
;
   end   start
```

the system is triggered not by the interrupt line being high, but by the transition from low-to-high. The CPU and PIC carry on running just as before. The only casualty is the IRQ line, which has now become blocked. No more interrupts can be generated on this line.

The primary object of any interrupt handler is to return control to the original process. This achieved, we can start to think about the special requirements of the UART interrupt handler. These are: to find out the source of the interrupt, to handle any data or error conditions and to end in such a way that the UART can interrupt again. There are four basic UART interrupts, and we can find out which one caused the interrupt by reading the UART interrupt identification register (IIR). Figure 4 shows what the contents of this register mean and how the different types of interrupt are serviced. Once this has been done, the UART drops its interrupt signal and we can proceed with sending the EOI to the PIC and restoring the original process.

Find the source

Time to look at the service routine in detail. The routine corrupts up to five registers (DS, AX, BX, DX and SI), so the first thing to do is to save these on the stack. (The only other stack usage is one near call. Thus six words of stack space are used in total, so I have not bothered to set up my own interrupt stack.) My code caters for four distinct types of interrupts: receive status interrupts, receive data interrupts, transmitter empty interrupts and modem status interrupts. A glance at Figure 4 shows that there are *five* possible results obtained from reading the IIR. If the result of reading the IIR was 1 - indicating 'no UART interrupt' - I should, in theory, chain to the old interrupt service routine. In fact, this is not necessary. Standard IBM PC UART boards do not support chained interrupts, because of the way the OUT2 line is used to condition the interrupt output: it acts as a sink for any signals on the same line. Consequently, if there is an interrupt, it must be from the UART. My routine uses a TEST instruction to detect this condition, and skips out of my IIR testing loop if it is found.

The four remaining possible values of the IIR are spaced at intervals of 2, so can be used directly to index a jump table of word addresses. The top five bits of the IIR are masked out before the value is used - for the reason see *The Thinking Programmer's Guide to UARTs*, .EXE Magazine, December 1989. The treated contents of the IIR are added to the address of the jump table of routines and the resulting address found in the table is called. The jump table routine services its specific type of interrupt. This enables the UART to generate further interrupts - it has been 'frozen up' since the original interrupt occurred. On return from the jump table routine, I loop round and re-check the contents of the IIR, just in case another interrupt is pending. This strategy avoids the overhead of generating and servicing another interrupt. If nothing needs attention, I write EOI to the PIC and return to the interrupted process.

My code shows how to discriminate between all four types of UART interrupt. It is actually quite common practice for only the receive interrupt to be enabled. This is because it is only the receive side which is really outside your control. It's often quicker and simpler to transmit characters as you need to send them. This only requires a check that the transmit register in the UART is free, while the overhead on transmit interrupt logic is more substantial. If we had enabled only the receive interrupt, we wouldn't have needed to read the interrupt identification register, as there would be only one possible source for the interrupt. Going through the code shown makes it easy to see that, for some applications, using transmission interrupt logic is less efficient than the polling of the status register and sending the characters as needed.

The receiving end

The `rxint` part of Figure 1 illustrates how to service receive interrupts. The routine just reads the data from the receive register and this ends the interrupting condition at the UART. Incoming data is saved in a simple 2 KB circular buffer. Sizes like 2048 bytes are frequently chosen for circular buffers, because they simplify the effort of making the buffer wrap around.

The code also handles hardware-level flow control, by dropping the RTS line when the buffer is three-quarters full. It does not wait until there is no room left, as the transmitter may not stop in time! In practice, this sort of problem (slow response) is more characteristic of software flow control such as XON/XOFF. (XON/XOFF software flow control consists of the receiver sending XOFF, usually character 13H, aka Ctrl-S, aka DC3, when it wishes to stem the flow of incoming characters, and XON/character 11H/Ctrl-Q/DC1 when it is ready to accept more). My code does not provide XON/XOFF flow control, but the modification is trivial. To stop the other end sending, all that needs to be done is to send out an XOFF, by inserting this character at the front of the transmit buffer.

To handle either type of flow control, the interrupt routine must set a flag for the non-interrupt 'application' part of the program, which removes the data from the receive buffer, so that it knows when to raise the RTS line/send an XON. Stopping the flow of characters is the job of the interrupt service routine, but restarting the characters is down to the application program. This is logical: the interrupt handler only knows when the buffer is filling up, as it never takes any characters out itself.

In my example, the place for these complementary flow control checks is the `read` routine. This is invoked by the non-interrupt driven part of the communications software, and extracts characters from the receive buffer. The queue logic is straightforward, and shows how the other side of the flow control works. Note that the application should raise RTS/send an XON *before* the buffer becomes completely empty. This is for the same reason that it tried to stop the incoming transmission before the buffer was totally full: there may be a delay before the other end responds, and it is desirable to minimise delays. The three-quarter level used in my code is a reasonable figure for most applications. It's worth emphasising one point made earlier regarding software flow control. When using transmit interrupts, you should treat the transmit buffer as a double-ended queue. Normal data goes in the back of the queue, but any XON or XOFF characters are placed at the front.

Transmit interrupts

The `txint` code handles the transmission of characters. The flow control is similar to the receive code - I use the CTS input to check whether I can transmit characters. Because there are two ways of servicing the interrupt, the position is more complex than for receiving characters.

The routine can transmit another character, or, if there are no more characters to send or CTS is low, it can just return - the act of reading the IIR was sufficient to service the interrupt. However, in this latter case, there must be some method of restarting transmit interrupt logic when there is data to send, or when CTS goes high again.

The first task is handled by the non-interrupt driven part of the transmission routine, in the `send` code part of Figure 1. It first checks to see if the transmit buffer is empty. If it is, the character just inserted is sent out by calling the `txint` routine, normally invoked by the interrupt mechanism, directly. The second problem, of resuming transmission after it has been stopped by CTS going low, is conveniently taken care of by the `modint` code for servicing the modem status interrupt. If CTS went high when the transmit buffer was not empty, the modem status interrupt simply vectors off to the transmit interrupt routine `txint`.

If your phone rings, it would be enough to crash your system. What was your number again?

A couple of points are worth raising regarding software flow control. The transmit buffer `send` code must ensure that there is room for one spare character in the transmission buffer, since our XON/XOFF characters are inserted at the front of the buffer, not the end. Second, detection and flagging of XON/XOFF characters from the receiving end ought to be done within our receive interrupt routine, so that we can respond promptly to requests from the other end of the link. A definite case of 'do as you would be done by'.

Another miscellaneous point: a consequence of using transmit interrupts is that characters get sent as a bit stream - the stop bit of one character is immediately followed by the start bit of the next. Any difference in speed between two systems will become cumulative, causing errors. The cure is to set the UART for two stop bits (rather than one). These will be inserted by the transmitter when sending, but are never needed by a receiver, even when its UART has also been set up to expect two stop bits.

When its transmit buffer is full, the sample program beeps for all further keyboard input. Obviously, this would be handled differently according to the needs of the application. The buffer sizes used in the code are also arbitrary, and could well be optimised for particular environments.

Loose ends

My program also contains code for the other two UART interrupts, line status and modem status. The line status interrupts consist of break detect and various error conditions. Generally these do not need any attention, as the UART does not require any error recovery action after these have occurred. The modem status interrupts are used in the sample code for flow control in the transmit logic, as explained above.

Finally, there is the `exit` code, which you will find just above the data area, which consists of the minimum you need to do to restore the system to a stable state when your program finishes. We have to disable the UART interrupts and restore the original interrupt vector. While the latter task is straightforward, we can disable the UART interrupts either via the interrupt enable register, or via the OUT2 pin in the modem control register, or via the mask byte on the PIC. Paranoid programmers will no doubt do all three, but any one of them should be sufficient.

Whatever you do, do not terminate your routines without doing something. The next program to load will overwrite your interrupt handler with a little something of its own. If the phone attached to your modem should ring, it would be enough to crash your system totally. I'm sorry, what was your number again?

EXE

Contents of IIR	Source of Interrupt	Action needed to service interrupt
xxxxx001	None	None
xxxxx110	Line status	Read line status register
xxxxx100	Receive data	Read data register
xxxxx010	Transmitter empty	Send another character, else cleared by reading IIR
xxxxx000	Modem status	Read modem status register

Figure 4 - Interrupt Identification Register

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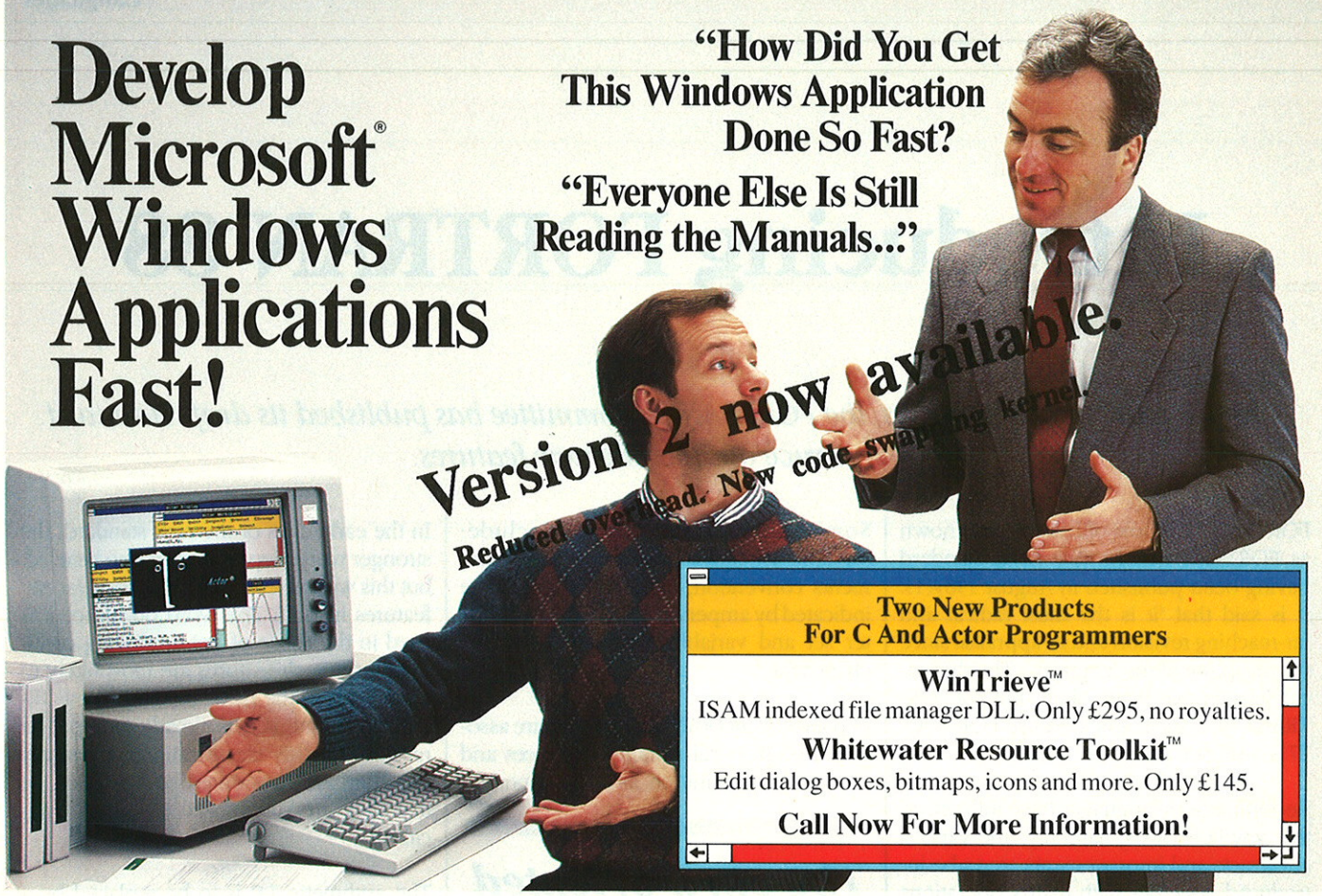

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CIRCLE NO. 792

Introducing FORTRAN 88

After 11 years of deliberations, the FORTRAN 88 committee has published its draft Standard. John Bruce outlines the new features.

FORTRAN 8X is now officially to be known as FORTRAN 88, the ISO Draft Standard having been published in August 1989(1). It is said that 'it is the most radical and far-reaching revision and re-appraisal since the inception of the language'. The rhetorical question has been asked, 'but is it FORTRAN?' Of course it is, because FORTRAN 77 is a subset of it.

Recent modern languages have influenced the new FORTRAN, naturally, and various constructs and improvements are to be introduced, together with matrix operations and vector processing. Software engineering features are included, which ought to enhance both quality and reliability.

FORTRAN 77 users will be glad to know that all of FORTRAN 77 is in FORTRAN 88. A major improvement is that the old card-oriented column restriction in source statements is to be replaced by a free form, with no column significance.

To summarise, FORTRAN 88 includes major extensions such as global storage and program packaging, whole array processing, user-defined type structures, pointers and dynamic storage management, parameter selectable intrinsic types, user-defined generic procedures, extended block structures, multiple I/O transfers per record (including variable-length character I/O), recursion, modular data and procedure definition.

Also introduced are parameterised `REAL TYPES` which will remove some of the present hardware dependent problems.

New concepts such as `MODULE`, `WHERE - ELSEWHERE - ENDWHERE`, `CASE` and block `DO` are all aimed at improving the structured programming facilities in the language. Last, but not least, free format source, where blanks are now very significant.

Some other major changes include: multiple statements per line; a new 'comments' convention; continuation lines to be indicated by ampersands; full ASCII character set and variable names of up to 31 characters.

In present FORTRAN, data objects are associated by physical storage sequences and not by object definition, as in more modern languages. `COMMON` and `BLOCK DATA` are two which have long been regarded as the cause of some bad programming practices. They are to be replaced by a `MODULE` definition facility. `EQUIVALENCE` is to be retained.

The card-oriented column restriction in source statements is to be replaced by a free-form with no column significance

New constructs will also allow arrays to be declared without specific dimensions, and the `DIMENSION` statement is therefore replaced by storage being `ALLOCATE`d and `FREE`d dynamically. `PAUSE`, alternate `RETURN`, `ASSIGN` and assigned `GO TO`, the 3-way `IF`, and real and double-precision `DO`s, come under the category of 'bad practice' which is said to inhibit good programming style.

In the early days of the new standard, the stronger word 'deprecated' was to be used, but this was watered down to 'obsolescent' features instead. The word obsolescent is used in the sense of not approving continued use. Such features are most likely to be deleted in the next standard (the FORTRAN 99 committee is already sitting). The reasons for this classification are usually that they are considered bad practice, or that they are superseded by superior facilities.

The arithmetic `IF` is to be replaced by a logical block `IF`. The Computed `GO TO` is superseded by a block `CASE`, and `DO` also includes a block `DO` construct. The `DIMENSION` statement is to include a `TYPE` statement. Object-oriented declarations are provided where value attributes for one named object are all contained in a single statement. Old-style FORTRAN 77 statements such as the `DATA` statement finds application here. `DOUBLE PRECISION` is replaced by parameterised `REAL TYPES`.

The `STATEMENT` function is to be displaced by more powerful internal procedures.

Selected Explanations

FORTRAN 88 differs from FORTRAN 77 in 12 major respects. In summary, and in alphabetical order, these are:

- *Additional input/output facilities.*
- *Array operations, including whole array processing.*
- *Free format source code facility (blanks significant).*
- *Improved facilities for numerical computation.*
- *Improved facilities for code portability.*
- *Larger character set.*
- *Modular data and procedure definitions.*
- *More control constructs.*
- *Parameterised intrinsic data types.*

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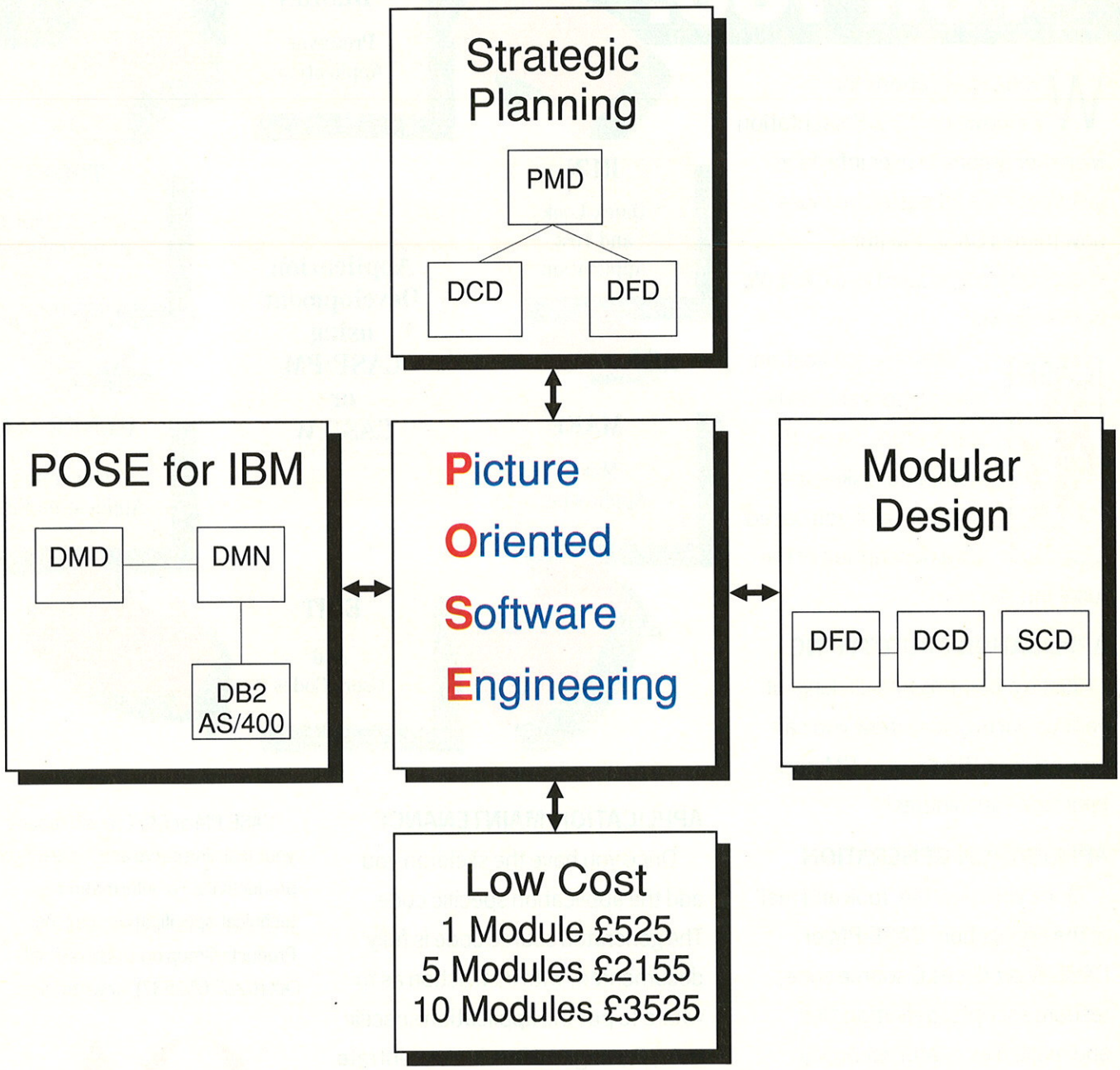

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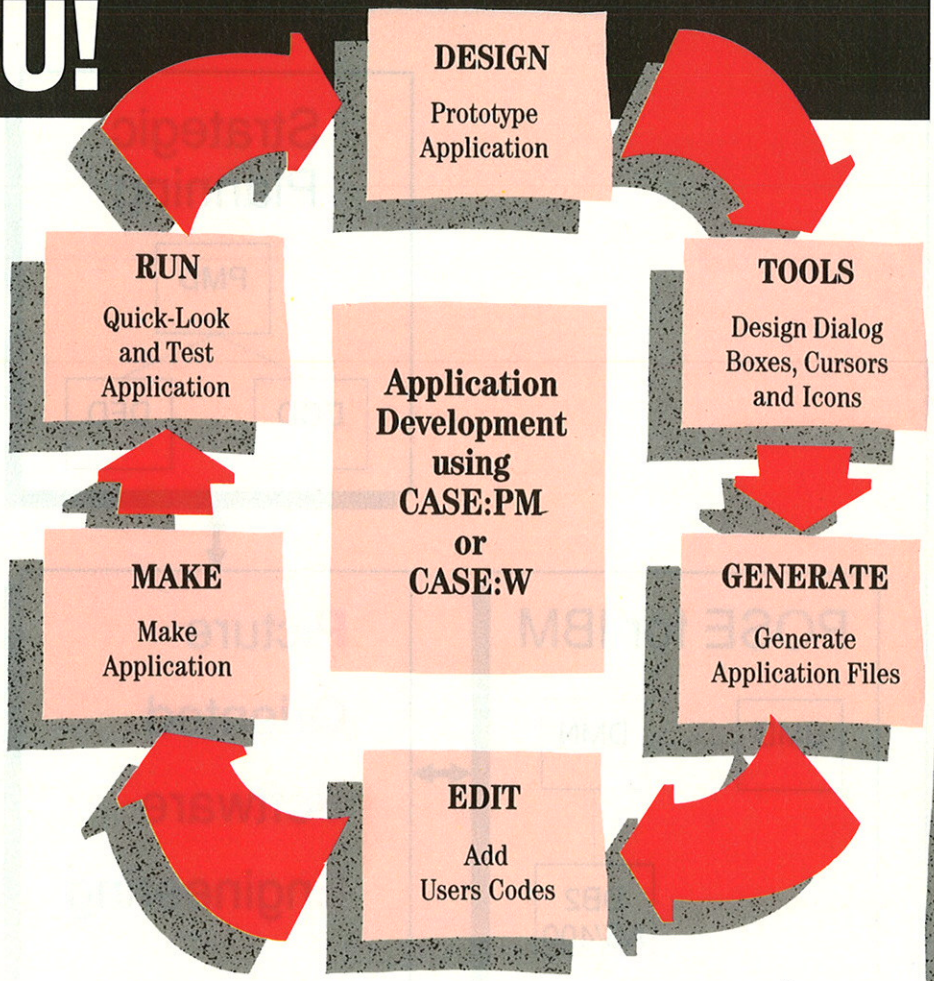

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CIRCLE NO. 794

- *Pointers and dynamic storage management.*
- *Recursion.*
- *User-defined data types, including generic procedures.*

Some other additions are:

- *Bit manipulation.*
- *String handling.*
- *Real-time clock.*
- *Random number generation.*
- *The concept of language evolution.*

Instead of examining each of the above changes, space allows only highlights to be considered.

Arrays

Arrays can now be fixed rank (dimensionality), or dynamically allocated. Elements must still be of the same type, or type declaration. Declaration statements take the form:

```
REAL, DIMENSION(10) :: A
CHARACTER, DIMENSION(80) :: LINE
```

Arrays can be treated as whole objects with operations applying element by element. For example, (note the new 'comments' convention), where:

```
REAL, ARRAY (5,4) :: X, Y
```

then

```
X.EQ.Y ! a 5 X 4 array with
       ! elements .TRUE. or
       ! .FALSE. according
       ! as X(I,J).EQ.Y(I,J).
```

Zero-sized arrays are allowed, and a lot more, as will be appreciated from such terms as PACK, UNPACK, RESHAPE, SPREAD, MERGE, and various other useful intrinsic inquiry and array shifting functions, as well as matrix and vector operations.

Space limitations prevent discussion of interesting concepts such as allocatable arrays, where size is not known until some calculations have been done, or data read. Automatic arrays and zero-sized arrays, and array-valued functions are some others. Heap storage is provided for, and also vector operations. The claim is rightly made that these new features are the hallmark of the new standard.

Control Constructs

Proper block loops have been introduced which eliminate the need for numbered labels. DO LOOPS are now delimited by DO and ENDDO statements. The DO becomes a 'conditional exit loop', as in:

```
DO
 statements
  IF(condition) EXIT
    statements
ENDDO
DO WHILE (condition)
  statements
   IF(condition) THEN
    statements
   END IF
ENDDO
```

The INDEXED DO LOOP is still available in its traditional form. Note that matching with a numeric label is not necessary, ie it can be a proper block construct.

```
   DO i = k1, k2, k3 ! k1, k2, &
k3 have the F77 meaning
    statements
   ENDDO
```

Loop-names and associated EXIT statements are now available:

```
     loop-name : DO
             statements
              IF(condition) EXIT
loop-name
             statements
           ENDDO loop-name
```

CYCLE is a most useful statement and is used within DO loops. In some ways CYCLE behaves like a GOTO in that it is a branching mechanism. If CYCLE specifies a DO loop-name, then it applies to that DO loop. Otherwise, it applies to the innermost DO loop in which it appears.

```
 OUTER: DO i = k1, k2
      first statement group
       IF(condition) CYCLE OUTER
       INNER: DO 10 j = k1, k2
          second statement group
          IF(condition) CYCLE
           third statement group
          IF(condition) EXIT
OUTER
10        END DO INNER
  END DO OUTER
```

The action of the two CYCLE statements is that CYCLE OUTER acts like a GOTO OUTER when some (condition) is derived in 'first statement group'. The CYCLE within the INNER loop belongs within that loop, and causes a branch to the INNER label when 'condition' is TRUE within 'second statement group'. Note the use of the 10 label as an example.

The major enhancement in control constructs is the introduction of the CASE statement. Here is a very simple example:

```
SELECT CASE (YEAR MOD 4)
  CASE (0)
   PRINT *, 'That year is a leap
year'
  CASE (1)
   PRINT *, 'That year is not a
leap year'
  CASE (3)
   PRINT *, 'Next year might be
a leap year'
  CASE DEFAULT
   ! This would normally catch
anything else
ENDSELECT
```

In SELECT CASE (case-expr) the 'case-expr' can be integer, character, or logical. The action of the CASE construct is to select at most one of its case blocks for execution. CASE selector (ie CASE (0) etc) can include multiple matching selectors, for example CASE (1, 3 : 5, 7) would select on 1, 3, 4, 5, and 7.

Another control construct variation is the DO WHILE (condition) ENDDO, where the condition is at the top of the loop.

Derived Data Types

FORTRAN 88 takes the language fully into structured programming with a good measure of typing. The old FORTRAN convention, that the first character in a variable name defines a variable's type, is still available. However, many FORTRAN users now

```
MODULE INTERVAL_ARITHMETIC
  TYPE INTERVAL
   REAL LOWER, UPPER
  END TYPE INTERVAL
  INTERFACE OPERATOR(+)
   MODULE PROCEDURE ADD_INTERVALS
  END INTERFACE
CONTAINS
  FUNCTION ADD_INTERVALS(A,B)
   TYPE(INTERVAL) ADD_INTERVAL, A, B
   ADD_INTERVALS%LOWER = A%LOWER +          &
    B%LOWER
   ADD_INTERVALS%UPPER = A%UPPER +          &
    B%UPPER
  END FUNCTION ADD_INTERVALS
```

Figure 1 - Example of module structure in FORTRAN 88

prefer to define all variables. User-defined types enable type definition to be separated from object definition. An example of type definition is:

```
TYPE PERSON
 CHARACTER(LEN=16) name
 REAL AGE, HEIGHT
 INTEGER WEIGHT
END TYPE PERSON
```

That data definition is called a structure, not a record as one might expect, because FORTRAN has always taken a wider view of what constitutes a record. Structures enable composite objects to be declared with separate components. A scalar variable of type PERSON can be declared such as TYPE (PERSON) FATHER. One can then refer to the AGE of FATHER as FATHER%AGE.

This is a real variable which can appear in expressions. If SON was also of type PERSON, then the difference in AGE could be computed as DIFF = FATHER%AGE - SON%AGE. Data is assigned to FATHER by FATHER = PERSON ('J Bruce', 34.3, 1.78, 140).

A wide range of parameterised intrinsic procedures is provided, the term 'intrinsic' meaning that it is defined in the standard. One of these is KIND, which is particularly valuable in ensuring code-portability between different computers. An error value is returned when the specification is not supported.

KIND(X) is an inquiry function that returns the kind type parameter of X. A kind type parameter is a parameter whose values label the available kinds of an intrinsic type. Two others relate to specified precision and range for integers and real numbers. These are SELECTED_INT_KIND(range) and SELECTED_REAL_KIND(decimal precision, decimal exponent range).

These functions return the smallest value of the kind type parameter for the specification. An example of use for named integer constants is:

```
INTEGER,PARAMETER::LONG =
  SELECT_INT_KIND(20)
INTEGER (KIND = LONG)
  ASTRONOMICAL
```

A lot more on KIND will be found in the references.

Input/Output

This area shows the least change. FORTRAN 77 (1978) introduced random access, file inquiry, list-directed I/O and some other innovations. One notable enhancement in FORTRAN 88 is NAMELIST, where I/O operations can be performed on a named group by replacing the FMT = specifier by a NML = specifier. Another enhancement is NONADVANCING I/O.

In this 'stream I/O' mode, where multiple I/O transfers per record (variable-length character I/O) are permitted, a file may be positioned at a character position within a record, instead of after the last record, as in advancing I/O. It is implemented by intrinsic procedures such as GET_CHARS, PUT_CHARS, and SKIP_TO_NEXT.

In FORTRAN 88 we now have a language capable of retaining the leading role in computational science

Interface

The concept of interfaces is relatively complex and extensive. However, interfacing places FORTRAN code at the same general level of security as that of Modula-2 or Ada. Essentially, the interface of a procedure specifies the forms of reference through which it is invoked.

Interface blocks allow the interface for an internal procedure to be declared and hence made explicit. The form of an INTERFACE block is:

```
INTERFACE
interface body
END INTERFACE
```

Operators (+,*,/, etc) are not automatically available for derived types. When derived types are defined, therefore, it is necessary to define the operators as well. See INTERFACE OPERATOR in figure 1.

Modules And Use

FORTRAN has always had a measure of implicit structured programming in its intelligent (and pioneering) use of function and subroutine subprograms. To these two program units, FORTRAN 88 adds a third, the MODULE. A Module is a method of making various specifications and definitions available to other program units, and also of accessing such definitions and specifications in other modules. These definitions can be data objects, declarations of constants and variables (possibly with initialisation), declaration of generic procedure names and operator symbols, definitions of procedures and derived types, definitions of interfaces for external procedures, and procedure interface blocks. A Module takes the form:

```
MODULE module-name
[specification-part]
[CONTAINS
module-subprogram-part]
END [MODULE [module-name]]
```

CONTAINS is a non-executable statement which separates any subprogram from the main body of a module or main program. If a branch has not occurred before a CONTAINS, then program action is to skip to END. A module can be accessed by other program units by the USE statement, which identifies the Module and imports the public objects. Note that a USE statement for a Module containing data declarations only is equivalent to an INCLUDE.

```
PROGRAM main
USE module-name
END PROGRAM main
SUBROUTINE sub-name
USE module-name
END SUBROUTINE sub-name
```

The USE statement can be qualified in a usefully structured way by the ONLY and rename-symbol (=) options. The statement has the forms:

```
USE STAT_PAK
USE MATH_PAK; USE STAT_PAK
USE MATH_PAK; USE STAT_PAK,
ONLY : SPROD = PROD, VAR
```

where VAR is accessed by its own name and PROD by the local name SPROD, if both MATH_PAK and STAT_PAK contained the entity PROD. ONLY limits access to only those specified parts of a module. A good example of module structure is given by Metcalf & Reid (2), which illustrates a number of FORTRAN 88 features. This is shown in Figure 1. An entity with a PRIVATE attribute is not accessible outside the module in which it is so declared. PUBLIC is the default, where attributes become accessible to other program units through the USE statement. The INTENT attribute specifies how a dummy argument is intended to be used. It has the form:

```
SUBROUTINE MOVE (FROM, TO)
USE PERSON_MODULE
TYPE(PERSON), INTENT(IN)
 :: FROM
TYPE(PERSON), INTENT(OUT)
 :: TO
```

Pointers

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Figure 2 - Sample program in FORTRAN 88

```
! Simple hand calculator simulation in FORTRAN 88
!
  REAL NUMBER, RESULT
  CHARACTER OP
!
  OP = '+'; RESULT = 0.0      ! multiple statements per line
!
  CALCULATOR: DO              ! DO - END DO loop until '=' sign
        READ *, NUMBER        ! read a number
!
    SELECT CASE (OP)          ! select on operator OP
      CASE ('+')
         RESULT = RESULT + NUMBER
      CASE ('-')
         RESULT = RESULT - NUMBER
      CASE ('*')
         RESULT = RESULT * NUMBER
      CASE ('/')
         RESULT = RESULT / NUMBER
    END SELECT
!
    READ *, OP            ! Read next operator
    IF (OP == '=') EXIT   ! goes to next executable statement
!
        END DO CALCULATOR
!
    PRINT *, 'Answer is ',RESULT
    END
```

The 'pointer' concept opens the way to dynamic data structures such as linked-lists and trees. These are recursive data definitions which optimise solutions by recursive methods (see RECURSION). An example of a recursive data definition (ie defined in terms of itself) is:

```
TYPE NODE
 INTEGER
 TYPE(NODE), POINTER
END TYPE NODE
```

Extensive pointer-based operations can be implemented by the keywords `POINTER`, `TARGET`, `ALLOCATE`, `DEALLOCATE`, `NULLIFY`, `FREE` and `ASSOCIATED`.

The subject merits an article on its own, but anyone familiar with the use of pointers will appreciate the power of FORTRAN 88 in this area from the following brief points:

1. The three attributes of a POINTER are type, rank and a pointer-name. The type has the usual meaning, and rank is dimensionality. The target of a pointer may be a variable, pointer-name, or function-reference which has the same type, type parameters, and rank as the pointer.

2. The syntax of `ALLOCATE is ALLOCATE (allocation-list[,STAT = stat])`. The DEALLOCATE command takes the same parameters. `NULLIFY (pointer-name-list)` is self explanatory. ASSOCIATION tests the association of pointer and target, and FREE breaks that association. An important consequence of the POINTER facility is that trees and lists can then be created.

Structured programming, and the modular concept, produces programs that delegate most of the work to subprograms. The next step is to cause a program, or subprogram, to call itself as a subprogram. That is recursion.

However, recursion is not always the best approach to solving a problem. Some practitioners believe that recursion is applicable only when the relevant data definition is itself recursive. Unfortunately, limited space prohibits an exploration of this interesting subject.

In a call to a FORTRAN subprogram, the value of variables cease to exist on return from that subprogram. This prohibits recursive calls in earlier versions of the language but FORTRAN 88 avoids this by explicit definition. `FUNCTIONs` and `SUBROUTINEs` can now call themselves by the addition of the keyword `RECURSIVE`.

Where

According to the Draft Standard(1) - `WHERE` is a masked array assignment and is used to mask the evaluation of expressions and assignment of values in array assignment statements, according to the value of a logical array expression. Such masked array assignments can be `WHERE` statements or `WHERE` constructs. It is therefore an assignment statement and not a blocked control construct. The form of the `WHERE` statement is: `WHERE (mask-expr) assignment`. Here, 'mask-expr' is a logical expression. Metcalf and Reid's book gives an alternative definition as:

```
WHERE (logical-array-expression)
array-variable = array expression.
```

The three expressions 'logical-array-expression', 'array-variable' and 'array-expression' are all arrays, and must have similar shapes. Evaluation starts with the first array-element and the appropriate array assignments are performed in turn according to that control mask. Note that only the array-elements (of array-expression) corresponding to elements of (logical-array-expression) are changed. Those elements of 'array-variable' which do not have the value TRUE, are left unchanged.

The `WHERE` statement can be used on its own, as in:

```
WHERE (A  0) A = ABS(A)
  ! the ABS function is
  ! invoked only for
  ! negative elements.
```

Note that when a non-elemental function reference appears in an assignment statement, the function is evaluated without any masked control.

Conclusion

Clearly, this has been only a brief look at FORTRAN 88. There is a lot more, otherwise the Draft Standard(1) would not be over 2 cm thick. The new FORTRAN is markedly elegant, and should satisfy those who want the advantages of software engineering. Current users of FORTRAN 77 can rest assured that the obsolete features will be there for another 10 years or so, because it is not permitted to delete a redundant feature in a standard unless notice is given in the previous standard. In any case, the new features are actually better, and will provide software that is more likely to stand up to the consequences of 'product liability'.

.EXE

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References

1. **FORTRAN 8X** - A Draft Revision of ISO 1539-1980

Programming Language FORTRAN. August 1989

British Computer Society, 13 Mansfield St, London WC1M 0BP

2. **FORTRAN 8X**- Explained, by M Metcalf & J Reid

Revised Edition, 1989, Oxford Univ Press.

Make it Smooth

If cheap video terminals can perform smooth scrolling, why can't a standard MS-DOS PC be persuaded to do the same?

If you've ever used a dedicated terminal, you'll probably have marvelled at the smooth scrolling on the screen. Rather than the screen's contents jumping up the screen a whole line at a time, the picture is scrolled smoothly, one pixel line at a time.

Both the VGA and EGA graphics systems have hardware support for smooth panning of the display in any of four directions. The program listed here adds smooth scrolling to DOS on a machine equipped with a colour VGA screen. It can easily be made to work with a mono VGA screen by changing the segment address of the video buffer. Smooth scrolling on an EGA works on similar principles, but the code would be more complex and the required modifications are not described here.

The program listed below should be assembled and linked to produce AUTOCUE.COM. To run it, type AUTOCUE X, where X is a letter from A to Z. The letter you choose changes the scroll speed. It's important to get it right for your system, in order to provide a smooth scroll. Keep trying different settings until it looks right. You can run AUTOCUE multiple times until the setting is correct. However, each time you run it, it eats up more RAM so, when the setting looks right, remember it and reboot.

Once the program is installed, smooth-scrolling is turned on and off with the Scroll Lock key. Assuming that Scroll Lock is on, any program that uses DOS to scroll the whole screen, will operate in smooth mode.

About Autocue

AUTOCUE installs itself as a TSR and monitors calls to the ROM BIOS interrupt 10h, function 0Eh. This is used to write a character to the display. When DOS scrolls the screen, it calls Int 21h function 40h to write a carriage return/line feed pair to the standard output device. This function ultimately calls the BIOS twice - once for each character. We trap BIOS calls to display a line feed, and replace the routine with our smooth scroll code. Many parts of DOS don't actually call Int 21h to do their scrolling, but call the BIOS direct. The TYPE command is one example. Therefore, for greater flexibility, we have to trap the BIOS rather than DOS. The only major problem with this method is that AUTOCUE has no effect when the ANSI.SYS driver is loaded. This is because most versions of ANSI.SYS use their own code to scroll the screen, and don't call the BIOS. Assuming you don't have ANSI.SYS installed, and that you do have a colour VGA system, your DOS directory listings and TYPE commands will scroll smoothly with AUTOCUE installed.

To scroll up by one character, AUTOCUE simply increments the PRS register from 1 to 15

How Autocue Works

Like all PC video cards, the VGA has a buffer that holds more text than can be displayed on the screen. A typical VGA card has 64 KB or 256 KB of buffer space, though a screen full of text takes only 4000 bytes (25 lines, 80 characters, 1 byte for each character and one for its attribute). In text mode, the screen acts as a window into this buffer. Normally, the window is showing you what's at the very top of the buffer. The reason that you are shown the top of the buffer is that the Preset Row Scan register on the VGA card is set to zero. This register specifies a pixel line in the video buffer, and the data to make the display is taken, starting from this pixel line. To smooth-scroll the screen upwards by one pixel line, you simply set this register to one. The top pixel line disappears from the top of the screen, and the pixel line that was previously below the bottom of the screen (ie, part of the video buffer that was not displayed) appears at the bottom of the screen.

To scroll up by one whole character, AUTOCUE simply increments the PRS register steadily from zero to 15 (a character is 16 pixels deep, so stepping from zero to 15 moves up a whole character). To control the speed of the scroll, we wait a while between each setting of the register.

Once the PRS reaches 15, the screen has been scrolled and AUTOCUE has done its job. However, we have altered the value of the PRS register, and the screen buffer is no longer in the same place in the video buffer as it was when DOS asked the BIOS to scroll the screen. This state of affairs will almost certainly confuse DOS, so we must put the PRS back to zero before we can safely return to DOS. Of course, putting the PRS back to zero will return the screen to its original position, thus undoing the scroll that we have just done. To compensate for this, we must block-move the 4000 bytes of screen memory back up the screen. Before resetting the PRS register and performing the block move, we turn off the screen by using another of the VGA's registers. Once

```
; AUTOCUE.ASM - Smooth Scroll for Colour VGA
; To create AUTOCUE.COM:
; MASM AUTOCUE;
; LINK AUTOCUE;
; EXE2BIN AUTOCUE.EXE AUTOCUE.COM
; DEL AUTOCUE.EXE

        code    segment
        assume  cs:code,ds:code
        org     0100h

slow_machine    equ  0   ; Slow machines may need the display
                         ; turned off during the block-move.
                         ; Before you resort to introducing
                         ; flicker, try a different speed setting
                         ; as this is probably less disturbing.

vrwait  macro            ; Wait for vertical retrace to occur
        local   horiz
        local   vert
        push    dx
        push    ax
        mov     dx,03dah            ; Select VGA status register
horiz:
        in      al,dx               ; Read it
        test    al,8                ; Wait for horizontal retrace
        jz      horiz
vert:

        in      al,dx               ; wait for vertical retrace
        rcr     al,1
        jc      vert
        pop     ax
        pop     dx
        endm

scrnoff macro                       ; Turn the screen off
        push    ax
        push    dx
        mov     dx,3C4h
        mov     al,1
        out     dx,al
        inc     dx
        in      al,dx               ; read sequencer register 1
        or      al,00100000b        ; set bit 5 to turn off screen
        out     dx,al
        pop     dx
        pop     ax
        endm

scrnon  macro                       ; Turn the screen on
        push    ax
        push    dx
        mov     dx,3C4h
        mov     al,1
        out     dx,al
        inc     dx
        in      al,dx               ; read sequencer register 1
        and     al,11011111b        ; clear bit 5 to turn on screen
        out     dx,al
        pop     dx
        pop     ax
        endm

start:

        jmp     init

intent:                     ; come here on all int 10h calls pushf

        cmp     ax,0E0Ah    ; Is this a call to write a line feed?
        jne     try_6
        cmp     bx,7        ; Is attribute = 7 and video page = 0?
        jne     intxeq
        jmp     proceed

try_6:

        cmp     ax,0601h        ; Is this a call to scroll 1 line?
        jne     intxeq
        cmp     cx,0            ; Is top left corner = 0,0?
        jne     intxeq
        cmp     dx,184Fh        ; Is bottom right = 24,79?
        jne     intxeq

proceed:

        push    ax
        push    ds
        mov     ax,0040h
        mov     ds,ax
        cmp     byte ptr ds:[51h],24; Is cursor on bottom line?
        jne     intxeq2             ; Else let BIOS do scroll
        test    byte ptr ds:17h,10h ; Scroll lock on?
        jz      intxeq2             ; Do now't if scroll lock off
        cmp     byte ptr ds:[49h],3 ; Is screen in correct mode?
        jne     intxeq2             ; If not, don't smooth scroll
        cmp     byte ptr ds:[62h],0 ; Is current video page = 0?
        jne     intxeq2             ; If not, don't smooth scroll
        pop     ds
        pop     ax

        push    di
        push    si
        push    ds
        push    es
        push    ax
        push    bx
        push    cx
        push    dx

        vrwait              ; Wait for vertical retrace to start
                            ; Now perform the smooth scroll. Bump
                            ; up the Preset Row Scan register slowly
                            ; From 1 to 15, which will scroll by one
                            ; pixel each time.

        mov     al,8
        mov     dx,03d4h
        out     dx,al           ; select VGA CRTC register 8
        inc     dx
        in      al,dx           ; read contents of reg 8 into al
      and     al,11100000b    ; clear lower 5 bits,ie the PRS reg-
ister
        mov     bx,0            ; Now scroll 15 scan lines
scanlines:
        mov     dx,03d5h
        out     dx,al               ; write new value to PRS
        inc     al                  ; And skip to next scan line
        mov     cx,word ptr cs:speed  ; Pause awhile
delay:

        loop    delay
        inc     bx              ; Adjust counter
        cmp     bx,16           ; Have we done 15 lines?
        jne     scanlines       ; No, then continue smooth scrolling
        if      slow_machine
        scrnoff                 ; Turn off the display to avoid
                                ; jumping during the following block
                                ; move.
        endif

        and     al,11100000b ; The smooth scroll is now done.
        out     dx,al        ; Roll the PRS back to 0. This will
                             ; un-scroll the screen again, so we
                             ; must block-move the 4K of text
                             ; and attributes to re-effect it.
                             ; This char scroll could be done
                             ; by passing control back to BIOS,
                             ; but would be slower.

        vrwait               ; Wait for vertical retrace to start
        cld
        mov     ax,0b800h
        mov     es,ax
        mov     ds,ax
        mov     si,160
        mov     di,0
        mov     cx,2000
        rep     movsw

        if      slow_machine
        scrnon                  ; Turn the display back on
        endif

        pop     dx
        pop     cx
        pop     bx
        pop     ax
        pop     es
        pop     ds
        pop     si
        pop     di

        popf
        iret            ; C'est tout.  Das ist alles.

speed   dw      0       ; Value to be obtained from command line

intxeq2:                ; Tidy up stack

        pop     ds
        pop     ax

intxeq: popf
        db      0EAH        ; Far absolute JMP (segment + offset)
intip   dw      0           ; Offset of jump. Filled by init code
intcs   dw      0           ; Segment of jump. Filled by init code

init:
        push    cs
        pop     ds
        mov     ax,1A00h
        int     10h             ; Get display type
        cmp     al,1Ah          ; Is this function supported?
        jne     complain        ; Exit if no
        cmp     bl,8            ; Is this a colour VGA display?
        je      continue        ; Continue if so

complain:

        mov     ah,9
        mov     dx,offset cs:nogreet  ; Must run on colour VGA
        int     21h
        int     20h

continue:

        mov     cl,ds:[80h]  ; Length of command line
        cmp     cl,2
        jne     bad_param    ; Parameter must be one char plus CR
        mov     al,ds:[82h]  ; Get parameter
        or      ah,00100000b ; Force to lower case
        cmp     al,'a'       ; Char must be between a and z
        jb      bad_param
        cmp     al,'z'
        ja      bad_param
        sub     al,96
        mov     ah,0         ; AX now holds the number 1-26
        mov     cl,10        ; 2^10 = 1024
        shl     ax,cl        ; Multiply by 1024, to give a delay
                             ; of 1024 (a) to 26624 (z)
        mov     word ptr cs:speed,ax ; Plug speed value into code

        mov     ah,9
        mov     dx,offset cs:greet
        int     21h             ; Display greeting message

        mov     ah,35h          ; Get address of Int 10h vector
        mov     al,10h
        int     21h
        mov     intcs,es        ; Save it in resident code
        mov     intip,bx
        mov     ah,25h          ; Now point to our code
        mov     dx,offset intent
        int     21h
        mov     ax,3100h
        mov     dx, (init-start)/16+17
        int     21h

bad_param:
        mov     ah,9
        mov     dx,offset cs:bpgreet
        int     21h
        int     20h

greet   db      'Smooth Scroll for VGA, by RJS ''89.
v1.2',0Dh,0Ah
        db      'Activate by turning on Scroll Lock.',0Dh,0Ah
        db      'NB: Incompatible with ANSI.SYS.',0Dh,0Ah,'$'
nogreet db      'This program requires a colour'
        db      ' VGA monitor.',0Dh,0Ah,'$'
bpgreet db      'Usage: AUTOCUE A (fast)'
        db      ' to AUTOCUE Z (slow).',0Dh,0Ah,'$'
code    ends
        end     start
```

the move is complete, we turn the screen on again. Turning the screen off during the move causes a slight flicker on the display. If the screen were left on, though, you would see the display scroll smoothly, then jump down and up sharply as the PRS went to zero and the block move took place. On a fast PC (a 386 machine at 20 MHz), this jump is not noticeable, so you could remove the calls to scrnoff and scrnon. On a 12 MHz 286 PC, the jump can easily be seen.

The slow_machine setting in the program listing allows you to specify whether the screen gets turned on and off. As with the speed setting, experiment to find the best solution for your hardware. Be warned, though, that you'll need a 16 MHz 386 machine to get flicker-free scrolling.

AUTOCUE will work with any programs that use DOS to scroll the screen. This is normally limited to directory listings and output from the DOS utilities. A program that calls Int 10h function 0Eh, to scroll the screen by displaying a line feed character, will also work. This includes commands like TYPE and SET.

Windows

The official way to use BIOS to scroll the screen is by use of Int 10h function 6. This allows the programmer to specify a rectangular window to be scrolled. Programming a smooth-scroll version of this function is not easy unless the program requests the whole screen, or at least an area the full width of the screen, to be scrolled. If a program calls Int 10h function 6 and asks for the whole screen (fixed at 25 lines, in this version) to be scrolled, AUTOCUE will cope with this request and perform a smooth scroll. If a program asks only for a specific area to be scrolled, AUTOCUE takes no further action, and passes on the request to the BIOS for normal character-mode scrolling.

In text mode, the PC's screen acts as a window into a large buffer of up to 256 KB

One of the best uses for AUTOCUE is with terminal emulation programs. Most of these have a status line at the bottom of the screen, and perform their scrolling by asking Int 10h function 6 to scroll the top 24 lines of the screen, and to leave the bottom line alone.

To get around this problem, instruct your terminal program to remove the status line, and to give you a full 25 lines for the communications window.

Alternatively, you could adapt AUTOCUE to cope with window-oriented scrolling. For windows where the screen is split into two, horizontally, this is not as difficult as it may seem, because the VGA card already has a split-screen mode. A little jiggling of some more registers would allow you to split the screen, smooth-scroll just one part of the display, and then re-join the two parts. This, as they say, is left as an exercise for the reader.

.EXE

Threadz Observer

Observer is a debugger for Windows applications, written and marketed by two ex-employees of Microsoft. Adam Denning tries it out.

What is Observer?

Observer is a utility for Microsoft Windows developers which assists in the debugging of their programs. Put simply, Observer sits between Windows and the application being debugged and lets the programmer trap all Windows function calls and messages.

At the most straightforward level, this means that a record of all calls made by a program, and all messages passed to a program through Windows, can be saved to a file (or displayed on a secondary monitor) as a program executes. As well as the calls and messages themselves, Observer records the parameters to each function and the fields of the message structure for each message (eg wParam, lParam, time etc). Optionally, Observer is also able to break (stop execution) on a call or a message. Every single Windows function and every single Windows message may be individually enabled or disabled for display and/or for breakpoint, or related groups of functions or messages may be enabled or disabled en bloc.

Observer also offers single-step facilities (between Windows calls and messages rather than between program source code statements), and has a facility that allows a developer to hook into the debugger and cause it to perform certain tasks. Observer also has a comprehensive help facility called The Book, which is different in approach from the majority of Windows help systems and is rather novel.

Who are Threadz?

Threadz is a small company set up by two technically oriented ex-employees of Microsoft UK. Both of them clearly know their Windows from their elbows, as it were. Having been at Microsoft a few years and learned a great deal, they decided it was time to go it alone. Observer is the Company's first commercial product, although they also offer Windows and PM consultancy (if anyone can do it, they probably can) and develop the odd little utility here and there.

Regardless of the price, serious Windows developers find it tremendously useful

Observer in Detail

The first great thing about Observer is that, to use it, you don't need to take any special actions with regard to Windows or program building. In other words, you don't need to run the debugging version of Windows and you don't need to re-build your program with special compiler and/or linker options. All you need do is install the Observer executable and its associated dynamic link libraries (DLLs) in the WINDOWS directory (or at least somewhere in the PATH).

To begin debugging, you simply run up Observer (under Windows, of course) and select the `Observe...` option from the File menu. This displays a list box containing executable files and another containing drives and directories, in normal Windows style. Once you've selected a file, a click on the `Observe` check box marks that executable file as observed. In practical terms, this means that the references to the Windows DLLs (USER, KERNEL and GDI) have been patched to refer to Observer's DLLs instead. Clicking this check box again resets the DLL references, allowing a file previously marked as observed to be returned to normal.

When a program marked as observed is executed, and Observer is running, a window opens up inside Observer's main window client area. This window is called the application window, and more than one can exist at a time (in other words, multiple applications may be observed simultaneously). Into this window is written each Windows call and message that the program makes or receives, assuming that such calls or messages are enabled.

Observer maintains another window, the toolbox window, which contains small icons depicting actions the programmer may take. Each icon is rather cute: a skipping person is the 'skip call' icon, a climbing stair is the single-step icon, a bible-like icon is an entry-point into The Book help system, a spanner icon is used to toggle the state of the toolbox window between fixed and floating, and a scroll bar with a snail at one end and a bullet at the other determines the speed at which an observed program is executed. Additionally, a traffic sign icon which switches between a 'no restriction' sign and a 'no entry' sign is used to stop and start an observed program, and a scroll icon is used to open a window which allows edits to calls within the program and standalone calls to be made.

Options can be set to determine the font used in the application window, whether the contents of structures are displayed,

whether the arguments to calls are typecast to show the types expected by the functions, and whether the call is displayed before or after it is executed. It's a pity that this flag is global and can't be applied to individual functions. As an example, it is almost always considerably more useful to see the results of a call to `GetTextMetrics` after the call, while the arguments to a call to `CreateFontIndirect`will most probably be examined prior to the call.

It is perfectly possible to observe more than one program at a time, to observe more than one instance of a program at a time, and to observe DLLs as well as normal executable programs. This pertains especially to CommonView users, who would notice a distinct lack of messages to their program unless they also remember to observe the CommonView DLL!

Observer as Instructor

Observer can be used in a number of ways, the most obvious of which is to capture all messages and calls to a file, to ensure that they occur in the sequence expected and that the responses to each are as planned. This is actually a good way of getting to grips with Windows programming in the first place, as it enables one to see the messages which are sent during window creation and through every moment of a window's life.

It can also highlight bugs. In one trivial case, I noticed that text I was outputting to a window in Helvetica 10-point was rather widely-spaced vertically. I was using the `tm.Height` value returned by a call to `GetTextMetrics` to determine the vertical separation, so I was bemused as to why the separation seemed to be awry. My call to `GetTextMetrics` was within the `WM_CREATE` handler for the window, and I ensured that my font was selected by a call to `SelectObject` before the call to `GetTextMetrics`, so I failed to see the problem. Observer showed me that the call to `SelectObject` was with a NULL object handle, which I didn't expect as my call to `CreateFontIndirect` occurred in WinMain before the main message loop.

It became obvious when I realised that I called `CreateFontIndirect` after I called `CreateWindow` and, as `CreateWindow` causes the WM_CREATE message to be sent, I was, as Observer was telling me, selecting a not-yet-created font into my device context immediately before the call to `GetTextMetrics`. This means that the device context was left with its default font (the system font), so the `tm.Height` value was inappropriate for the font I was actually using when it came to the painting.

Admittedly, this is a fairly stupid bug, but Observer made it much easier to find because it (optionally) highlights NULL handles and pointers in the output it produces. Part of an example of Observer's output is shown in Figure 1.

Observer as Debugger

Another way in which Observer may be used is similar to the first except that specific sets of messages and/or functions are enabled. For example, if a programmer was implementing the client end of a DDE link, he may choose to trap and display only DDE messages.

It is possible to observe more than one program at a time, and to observe more than one instance of a program

Observer allows this technique to be usefully expanded by letting the programmer set breakpoints on specific messages or calls. Unlike conventional debugging, where breakpoints are usually set in the client code (ie the code making the request - your source code), Observer effectively sets breakpoints in the server code (Windows). The distinction is fine, but is more apparent in single-step mode: this executes a program up to the next Windows call or message, so it is single-stepping Windows interfaces rather than source code instructions. For the sorts of bugs Observer would be used to find, this is of course ideal.

When a breakpoint is reached, execution may be continued or parameters to the call/message can be changed before it is executed. Also, it is possible to skip the current message or call altogether.

The breakpoint mechanism, together with the selective display of calls and messages, would of course be used in much the same way as a conventional debugger such as Microsoft's CodeView. If, for example, conversations between a window and a list box seem to have no effect, you may decide to break on `SendMessage`, whereupon you might discover that you've accidentally swapped the high and low order words of `lParam`. By breaking on `SendMessage` and changing the value of `lParam` appropriately, you can see quickly whether this is the problem or not without having to edit your source code and rebuild your program.

Experimentation

Perhaps the most interesting and absorbing part of Observer is the stand-alone calls interface. By clicking on the scroll icon, one can enter any call to Windows one wishes and execute it there and then. Hence, one can create a window by calling `CreateWindow`, and then perform all sorts of operations upon it, such as getting a device context for it and drawing on it, and then finally one can destroy the window. Apart from such experimentations, one can also issue calls to affect windows already in existence, such as the windows created by a program being debugged, or even to windows belonging to entirely separate programs. For example, by using something such as the Spy utility (supplied with the Windows SDK) to find out the handle to Excel's main window, it is possible to change Excel's title bar to say something other than 'Microsoft Excel' (although not for long, as Excel seems to change it back at every re-paint). This particular instance is perhaps not the best example, but the technique is clearly powerful and of use to Window developer.

This feature comes into its own when the action of a previously untried function is to be determined empirically, which is almost always considerably more amplifying than attempting to understand the SDK's documentation. I've also used it to determine the best relative dimensions for an arrowhead-shaped control I was designing - by issuing vast numbers of `MoveTo` and `LineTo` calls, I eventually arrived at a set of points which I could pass to the Polygon function in a real program (I didn't try to call Polygon from Observer like this as it needs the address of an array of POINT structures - something with which I couldn't provide it other than from within a program).

Observer's Interface

So far, all use of Observer has been typified by being non-interventionist, ie no change was required to the program to be debugged except that it needed to be selected

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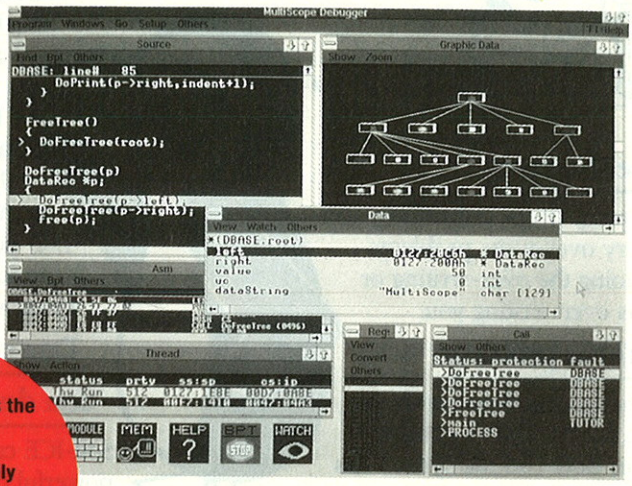

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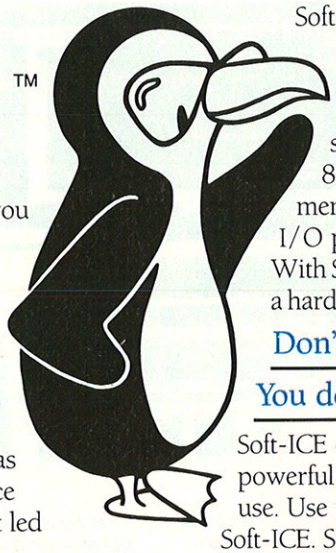

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as observed from an Observer dialog box. The programmer's interface, however, presents the other side of Observer. Here, the programmer is at liberty to write code which controls Observer.

Observer comes with an `include` file and a set of libraries which may be used to control certain aspects of the debugger. In particular, a programmer can cause Observer to open a data window, display strings, pause the program, restart, set the debugging speed, enable or disable all functions and all messages, and set the display-after-call flag.

These facilities are useful, but so far I have taken advantage of Observer's other facilities rather than the PI. The PI is probably most useful when something really elusive is happening, although I suspect that such an occasion is probably better solved with the judicious use of CodeView.

The Book

Observer offers help in three ways: the F1 key, the Help menu option and the bible icon in the toolbox. When help is selected, a new window opens. Inside this window is a rendition of a ring-bound computer manual open on its title page, with dog-ears at the bottom of each page and tabs delimiting the sections of the manual. This is called The Book by Threadz, and is easy to use. If you click on a dog-ear, the next or previous page of the manual is displayed; if you click on a tab, the title page for that section is displayed and if you click on the manual background (the binder, so to speak), you are returned to the front page.

Although the book concept is good and potentially general enough to be licensed in its own right, it's interesting to note that Threadz has used it here to perform what must be an application-specific task: the manual pages for the messages and calls allow each message or function to be enabled or disabled for display and breakpoint, simply by moving the mouse cursor to the relevant box alongside the message or function name, and clicking the button. This is certainly useful, although the task is probably easier from the Observer menu.

Also, the Book does not have a context-sensitive mode, as no matter where you are, asking for help always takes you to the book's front page. Unlike help systems such as Microsoft Excel's, it is not possible to request help while performing 'system' actions, such as scanning through menu options or responding to dialog boxes.

Conclusion

A couple of problems came to light during my initial use of Observer. The first is its complete failure to work with Windows/386, despite the presence of a Win386 flag in the WIN.INI file which it purportedly recognises. Threadz acknowledges the problem and is striving to fix it, although the problem may well lie with Windows/386. A further problem which only recently came to light, is that it seems not to work with the LIMSIM expanded memory manager on my 386 SX machine. I have yet to speak to Threadz about this.

Despite the obvious cuteness in places (the Book, the toolbox icons and the 'About' box), Observer is definitely a useful debugging and instructional tool. If you are a commercial Windows developer, you'll want a copy of Observer as soon as you can get one.

If you are a private developer or just someone playing around, you may feel that £495 is rather a lot to pay for a debugger. I agree - I think that Threadz could do itself a lot of favours by offering its excellent and almost indispensable tool more cheaply.

Perhaps it could be split into two products - a professional system which offers everything, and another version which has the majority of the facilities but is missing, say, The Book.

Regardless of the price, serious Windows developers will find it tremendously useful. PM developers should bear in mind that Threadz is bringing out a PM version soon. .EXE

Figure 1 - Sample Output from Threadz Observer

```
  0036 CreateFontIndirect( (LOGFONT FAR *)0x40CB:6E )
  0037 LPLOGFONT-
lfHeight  13   lfWidth   0
lfEscapement   0    lfOrientation  0
lfWeight  700  lfItalic  1
lfUnderline    1    lfStrikeOut    0
lfCharSet 0    lfOutPrecision 1
lfClipPrecision     2    lfQuality 0
lfPitchAndFamily    34   lfFaceName     "Helv"
  0038 = (HFONT)0x8EA
  0039 Warning - Null Handle!
  0040 LoadCursor( (HANDLE)0x0, (LPSTR)0x0:7F02 )
  0041 = (HCURSOR)0xA2
  0042 LoadCursor( (HANDLE)0x472, (LPSTR)0x0:36 )
  0043 = (HCURSOR)0x4A2
  0044 Warning - Null Handle!
  0045 LoadCursor( (HANDLE)0x0, (LPSTR)0x0:7F00 )
  0046 = (HCURSOR)0x9E
  0047 SetCursor( (HCURSOR)0x9E )
  0048 = (HCURSOR)0xA2
       0049    LoadString(     (HANDLE)0x472,     (unsigned)55,
(LPSTR)0x40CB:1F4E, (INT)512 )
  0050 = (INT)7
  0051 LoadIcon( (HANDLE)0x472, (LPSTR)0x0:34 )
  0052 = (HICON)0x4BE
  0053 RegisterClass( (LPWNDCLASS)0x40CB:17A0 )
  0054 LPWNDCLASS-
style:    0x3
lpfnWndProc:   0x1B05:1D3
cbClsExtra:    0
cbWndExtra:    0
hInstance:     0x472
hIcon:    0x4BE
hCursor:  0x0
hbrBackground: 0x6
lpszMenuName:  MAKEINTRESOURCE( 50 )
lpszClassName: "AgbHelp"
  0055 = (BOOL)TRUE
  0056 lstrcat( (LPSTR)0x40CB:1F4E, (LPSTR)0x40CB:44 )
  0057 = (LPSTR)0x40CB:1F57
  0058 RegisterClass( (LPWNDCLASS)0x40CB:17A0 )
  0059 LPWNDCLASS-
style:    0x0
lpfnWndProc:   0x1B05:1FF
cbClsExtra:    0
cbWndExtra:    0
hInstance:     0x472
hIcon:    0x0
hCursor:  0x0
hbrBackground: 0x6
lpszMenuName:  (null)
lpszClassName: "AgbHelprt"
  0060 = (BOOL)TRUE
       0061    LoadString(     (HANDLE)0x472,     (unsigned)51,
(LPSTR)0x40CB:1F4E, (INT)512 )
  0062 = (INT)23
  0063 lstrlen( (LPSTR)0x40CB:1F4E )
  0064 = (INT)23
       0065    LoadString(     (HANDLE)0x472,     (unsigned)55,
(LPSTR)0x40CB:1F66, (INT)512 )
  0066 = (INT)7
  0067 Warning - Null Handle!
  0068 Warning - Null Handle!
  0069 Warning - Null Long Pointer!
    0070  CreateWindow(  (LPSTR)0x40CB:1F66,  (LPSTR)0x40CB:1F4E,
(DWORD)0xFF:0, (INT)280,  (INT)80, (INT)320, (INT)300, (HWND)0x0,
(HMENU)0x0, (HANDLE)0x472, (LPSTR)0x0:0 )
```

Adam Denning is PC Development Manager with AGB Research, London, where he writes Windows and PM applications. Threadz Observer costs £495. The Company can be contacted on 0628 29129.

Out of Memory?

MS-DOS can't normally cope with more than 640 KB of RAM. There are a number of ways of increasing this limit, though, as Mark Morgan Lloyd explains.

The majority of people who run out of memory are not programmers, although they may regard themselves as power users. The most common situation is that they have a 286 or a 386-based system, and they have been running a memory-hungry DTP package or an integrated business environment. Then they add a network card plus the driver software, and there is no longer enough space for the application. There are a few things which can be done to help these unhappy souls, but in most cases some technical expertise is needed and it may be necessary to buy extra memory.

More fortunate is the programmer who realises, with some time to spare before his deadline, that he is running out of space. In general, it is safe to assume that a program of 384 KB will run on any system, including Windows/386, DOS + MS-NET, DESQview, the OS/2 DOS box, CDOS etc. Once the program gets larger than 450 KB, however, there will almost certainly be problems eventually.

One minor thing to bear in mind is that, while the size of the object file produced by different compilers for the same source code is more or less constant, different linkers have widely differing abilities when it comes to removing code that will never be called and ensuring that a procedure does not have to be repeated in two different overlays. Even though a modern compiler can generate code that is at least as good as the average assembler programmer the overall size of a program coded in a high-level language is still much larger so, if you want to write really tight code, my advice is that it's time to resort to assembler.

Of course, in a few years' time, memory problems will largely be solved by OS/2, particularly on the 386. The pace of OS/2's acceptance is really no slower than that of DOS in the early 80's. If you don't believe me, read the issues of Personal Computer World, Byte, Dr. Dobb's Journal etc. that followed the launch of the IBM PC: for a long period afterwards, people were still writing exclusively for CP/M-80 and were very hesitant about porting to a 16-bit chip. At the time, the most popular PC add-on was a Z80 card, and, of course, everybody would be running UNIX in a year anyway.

Different linkers have widely differing abilities when it comes to removing code that will never be called

What's Available?

Before discussing some of the products that can help you write larger programs, it's time to clear up a detail of terminology. Many people get confused between extended and expanded memory. Extended memory is linear memory above 1 MB. Expanded memory is paged memory, where different banks are switched into a visible area on demand.

Almost all compilers in the PC environment emit files in the 'standard' Intel/Microsoft object format, where the .OBJ file contains not only code and initialised data, but also information allowing external procedures to be invoked by name, and procedures stored in the module to be made public. It is the task of the linker to pull together the object files which form the various modules of a program, merge these with one or more libraries containing startup code and predefined procedures, and to produce a .EXE file with (sometimes) one or more overlays. Most compilers have a preferred linker which is generally compatible with Microsoft LINK. Because .OBJ file formats are fairly well understood, it is possible to replace the standard linker with something more flexible.

The traditional Microsoft linker (the 'Overlay' linker, to distinguish it from the OS/2 and Windows 'Segmented' linker) has two main failings: it is unable to ignore unused code, and it is limited to handling a single overlay area in the executable image. The former problem is generally insoluble unless the compiler co-operates: most Modula-2 environments trim redundant code, but the only C compiler I know about that does this is the new JPI TopSpeed C, which uses the same code generator and linker as their tried, tested and (generally) trusted Modula. There are, however, at least three ways of improving the overlay structure. These are RTLink, Plink and DLLs.

RTLink

In the United States, Pocket Soft Inc. have a linker called RTLink that will accept standard .OBJ files and produce a set of output files which are either read at load-time or loaded as overlays during execution. This approach allows library files to be shared between a number of application programs, and can reduce the amount of memory required. There are two crucial defects with this product, though. First, there is no addition to the DOS API to allow modules to be loaded by name on demand (eg graphics drivers for a particular device). Second, the format of the output files is

undocumented and proprietary and, if I can't see what is going on, I really don't want to use the product.

Plink

Plink-86 Plus started life as a Phoenix product but is now handled by Polytron. It's so widely used as to be almost an industry standard. I regard the transfer as a good thing, since Phoenix has not been very keen on supporting it of late whilst Polytron's support is second to none.

Plink is capable of handling both the Intel and Microsoft variants of the .OBJ format (though CodeView debugging information is lost) and it can produce several different overlay structures. There are two crucial differences between Plink's overlay management and Microsoft's. First, the Microsoft linker and manager code will only handle a single overlay area, which gives severe problems when a procedure in one overlay attempts to call code in a different one (the calling overlay may not be reloaded if the call is through a function pointer or procedure variable). Second, Microsoft stores all overlays in the main executable file, which can easily get larger than 1.2 MB (you've probably wondered how recent Microsoft applications can have .EXE file sizes of greater than 640 KB. Now you know).

Plink will manage several overlay areas, and can load overlays from multiple files. What is more, some of the source code of the overlay manager is supplied, and several useful entry points and data structures are documented. Also, one of the pre-built overlay managers allows overlays to be preloaded into expanded memory then copied into main RAM as required, which is probably one of the best ways to handle large applications on 8088-based machines.

The DLL

Yet another approach is exemplified by JPI's TopSpeed C, where OS/2-style dynalink libraries (DLLs) may be stored in standard OS/2-format .EXE files ('New', or 'Segmented' executable format) and pulled into memory at load time. This is particularly interesting when viewed in the light of Microsoft's apparent policy of using OS/2-style executables for the DOS versions of their languages (so far, Quick C 2.0 and FORTRAN 5.0 implement this). Unfortunately, no product I know of, except OS/2 and Microsoft Windows, allows a program to pull in procedures from a standard DLL on demand. I am confident that over the next year or so we will see far more development environments supporting the new file formats, provided that techniques can be developed that prevent any significant delay when a program is being loaded. If

The traditional Microsoft linker is unable to ignore unused code and is limited to a single overlay area

competing products like Plink and RTLink fail to conform to this new standard, there will be little to recommend them except in special cases such as embedded system work.

LIM Memory

Another enhancement that may be applied to any type of system is the addition of expanded memory conforming to the EMS (LIM) standard or its supersets EEMS and LIM 4. In the case of 8088-based systems such as the original PC, expanded memory can be installed by the addition of a memory board such as the Intel Above Board. However, many AT-compatibles now carry 1 MB as standard, with the extra 384 KB available either as extended or hardware-implemented expanded memory. In both these cases, the extra RAM is mainly of use for storing data although, if EEMS or LIM 4 is available, an operating system such as DESQview or CDOS-XM can switch memory on a per-process basis, allowing each program access to about 450 KB plus a predefined number of EMS pages for data.

More on LIM

A closer look is in order at the way a program may use expanded memory. In the case of version 3 EMS drivers and hardware, the installation of a suitable board adds an extra 64 KB of visible memory, typically at address D000:0h. This actually comprises four 16 KB physical pages, each of which may contain a designated logical page with mapping operations being almost instantaneous. There are a number of high-level libraries available to manage this, one of the best being The Heap Expander which manages allocation and deallocation of objects of up to 16 KB with minor changes to the

source. EEMS and LIM 4 add the ability to back-fill the PC's memory space down to (say) 256 KB, allowing an operating system to manage memory; an interesting feature of LIM 4 is its support for running TSRs in banked memory, although I do not believe that it is possible to switch a TSR into memory when its hot-key is pressed unless the TSR is specially written to do so (there are special memory managers that will do this, such as Headroom or Software Carousel). As far as I know there is no language implementation or support library which can make use of the facilities added by LIM 4 for overlay management - they are really there for operating system use.

On 286-based systems which do not have hardware support for banked memory, it is possible to use a software driver such as VEMM from Fort's Software to provide EMS support: but there are two problems. The first is that, since there are no facilities on the 286 for mapping memory in real mode, the driver functions by copying data from above 1 MB into the page frame - this can be very slow, since not only does it involve moving 32 KB (save 16 KB, load 16 KB) of data per operation, but also a switch between protected and real mode (otherwise you can't access memory above 1 MB) which involves resetting the processor. Second, the alert reader will have realised that, since the 286 is unable to conjure physical memory out of thin air (this is exclusively a 386 trick), the page frame is put at A000:0h, resulting in the loss of 64 KB of conventional memory.

To summarise, if losing 64 KB of code space is not too high a price to pay for 384 KB of banked data, and if speed is not too important, 286 extended memory can be used as expanded memory. Otherwise, trade the machine in and buy a 386 SX. Few people realise that a 386 SX with 2 MB of extended memory is cheaper than a 286 with the same amount of expanded memory.

On a 386 (also a 386 SX or a 486), paging facilities on the chip allow extended memory to be used as expanded without the loss of any conventional memory and without any speed degradation. So far so good, but there's more to come. Several 386 memory managers allow device drivers, TSRs and even part of COMMAND.COM to be loaded into memory above 640 KB. It is not unusual for QEMM, for example (the 386 memory manager that's part of DESQview 386) to allow 128 KB of low memory to be freed in this way as well as providing a 64 KB page frame for EMS. Look up the LOADHI command in your DESQview manual if you want to know how.

I regularly load ANSI.SYS, a mouse driver, menu handler, CD-ROM drivers and NetBIOS interface into high memory, although the loading order is important so that, if high memory is exhausted, they are loaded in low memory with as little waste as possible. Needless to say, DOS applications run without modification, the only caveat being that it may be difficult to set up this type of driver, although the latest version of QEMM has improved memory-usage detection and is claimed to be foolproof on 386-based PS/2 systems.

On 286 systems it is possible to use a software driver such as VEMM to provide EMS support

If an application is being written from scratch the programmer can, if suitable expanded memory is available, make use of the inter-process communication facilities of an operating system such as DESQview or CDOS by splitting it up into multiple programs. Each program is loaded into a session with the maximum amount of memory available (typically 450 KB) and communicates through named queues or whatever. The key here is to use the operating system for the dirty work, since as soon as any shared memory or interrupt vectors are used, multiple programs have to exist in the same bank of memory. An example of this technique is a prototype business-automation system running at Grey Matter, where the NetBIOS driver and network interface run in one DESQview session, passing messages to application programs running in their own memory.

HIMEM

Another scheme to be aware of, which Microsoft are implementing, is known as XMS. This is the Expanded Memory System, which is normally managed by a driver called HIMEM.SYS which accompanies some versions of Windows. This standard, which is still rather immature, attempts to provide minimal memory management for the following areas: the High Memory Area (HMA) between 640 KB and 1 MB; the Magic Segment, which is a little-used feature of the 286 and 386 whereby an additional 64 KB segment is available in real mode starting at FFFF:0h; extended memory above 1 MB.

In all these cases, the driver allows a program (typically a TSR) to claim an area of memory and later release it. The Standard does not provide services to allow a utility to determine which process owns a given resource etc. The best description that I have seen of this so far is on the Microsoft Programmer's Library CD-ROM. This even includes the source of an example driver. As far as I know, only Windows currently uses HIMEM, although it would be possible for a TSR to load itself into the magic segment to save low memory, as discussed earlier for LIM 4.

Extenders

So far, I have considered overlay and expanded memory techniques, which are largely applicable to any type of system. A class of operating-system extension that has caused a great deal of interest over the last year is the DOS Extender. Here, a program is modified to run in protected mode under DOS, with the extender switching between real and protected mode as appropriate. This concept was discussed fully in the review of the Phar Lap development tools, in February's issue of .EXE. I normally recommend caution when people tell me they want to use protected mode or extended memory, since there are no universal standards for this and programs have a nasty habit of tripping over each other. However, the two major DOS extenders for the 386 from Phar Lap and Eclipse Computer Solutions (formerly AI Architects), both make use of a protocol termed VCPI (Virtual Control Program Interface) which allows them to share a system with either the QEMM or 386-Max memory manager. This allows the protected-mode kernel to claim memory back for the use of the application program and opens the door to 32-bit programs running under DESQview.

The third product is DOS-16M from Rational Systems. This does not conform to the VCPI standard, so it should be able to handle the presence of VDISK or whatever, but otherwise is limited. The same also applies to home-grown extenders such as the one built into Digitalk's Smalltalk-V/286.

The PharLap DOS Extender allows programs written using a 386-specific compiler such as Metaware's High-C 386 or Lahey FORTRAN F77L-EM32 to run in protected mode. However the DOS extender and Metaware compiler together cost more than

£1000. Rational Systems produce the DOS-16M extender which is used by many high-volume products such as the circuit simulator pSpice. This can use standard 16-bit compilers but there is no retail variant at the time of writing.

The really interesting products of the bunch are the Eclipse extenders OS/286 and OS/386. Both of these allow programs produced by a range of 16-bit compilers including Microsoft C (running under DOS) to be run in protected mode. OS/386 also allows 32-bit compilers to be used. One of the most interesting features of OS/386 is its ability to set up the memory map in such a way that *635 KB* of memory is visible to an application program *without modification*, or *955 KB* provided that the screen memory is not accessed directly, or with a minor patch if it is. This really is an extremely exciting product, and I hope to examine it more closely in a future article.

Choices

The uptake of OS/2 is still comparatively slow. However, if I were responsible for porting a program to a more sophisticated environment and had a free hand, OS/2 is what I would use, particularly bearing in mind the robustness of OS/2 v1.1 (except for the DOS box) and the fact that it provides both multitasking and 'real' memory management facilities in the same package. Unfortunately, many people fail to appreciate just what OS/2 is: any operating system is not so much a chunk of code as a collection of interfaces and this is where OS/2 excels since, in its minimum form, it comprises little more than a multitasking kernel with DLL management. Practically everything else is an extension, including the user interface, and large elements of the file system.

My own practice is to use OS/2 as the model of which services may be used in the PC environment, and which are to be avoided. For instance, OS/2 provides calls `VioGetBuf()` and `VitShowBuf()`, which return the address of the logical screen buffer and flush (a portion of) the logical buffer to the physical screen on request. In most other operating environments, including DESQview, Phar Lap and Eclipse DOS Extenders, CDOS etc, there are analagous services so that an application program may write directly to an area of memory for speed rather than going through the comparatively slow DOS calls, so these two functions may be re-implemented as appropriate. On the other hand, under DOS it is possible to set up the EGA so that a 512-character font is available (this may also be used to display a small graphics image in text mode), however no other operating systems allow this so (useful as it is) I feel that it should be avoided.

Conclusion

This article has examined a number of ways in which the memory available on a range of machine types may be used more effectively.

On an 8088-based system, the best hope is overlays, although a program may also be broken up to run in multiple sessions under an operating system such as DESQview (with an expanded memory card). On a 286, the best bet is OS/2, however Eclipse's OS/286 is also well worth looking at. On a 386 there are many choices, including saving low memory by moving drivers above 640 KB, but my choice would be between OS/2 and OS/386, with the latter providing a much larger memory to an unmodified program.

These are all available from Grey Matter, for the indicated price. Other suppliers should also be able to obtain them. .EXE

A 386 SX with 2 MB of extended memory is cheaper than a 286 with the same expanded memory

Mark Morgan Lloyd spent a number of years at Grey Matter, supporting users and potential purchasers. He is now a freelance consultant and programmer.

PRODUCTS MENTIONED ABOVE

RTLink:
Pocket Soft Ltd, £180.

Plink-86 Plus:
Polytron, £320.

Topspeed C:
Jensen & Partners International, from £135.

VEMM:
Fort's Software. £80.

QEMM:
Quarterdeck Office Systems, £39.

PharLap DOS Extender:
PharLap, £400.

3+Open in Action

Chris Adie concludes his investigation into the merits of the 3+Open network, based around the OS/2 LAN Manager.

The protocol stacks used by 3+Open are shown in Figure 1. At the physical level, both Token Ring (using the IBM Token Ring Adapter and 3Com's Token Link card) and Ethernet (using 3Com's Ethernet cards) are supported. Higher up the stack, an enhanced version of the SMB (Server Message Block) protocol, familiar from MS-NET, is used. The 'filling' of the protocol sandwich can at present be XNS, DCL or NBP.

XNS (Xerox Networking System) is the protocol used by 3Com's older 3+Share generation of LAN operating systems. It runs over both Ethernet and Token Ring, but it does not use the IEEE802.2 Link Layer Control (LLC) protocol - it runs directly on top of the IEEE802.3 (Ethernet) or IEEE802.5 (Token Ring) Medium Access Control (MAC) layer. Strictly speaking, XNS (in common with NBP and many other protocols running over Ethernet) does not even conform to IEEE802.3, since it uses an earlier Ethernet standard. At its upper end, XNS provides a protected-mode NetBIOS interface for SMB and applications programs to use. One of the machines on the LAN (usually a fileserver) must be running the 'Locator' service, which is effectively a database of NetBIOS names. A mixed 3+Share and 3+Open network will use the same Locator, which represents a single point of failure on the LAN. It is, therefore, probably best not to use XNS unless you do need to interwork with 3+Share.

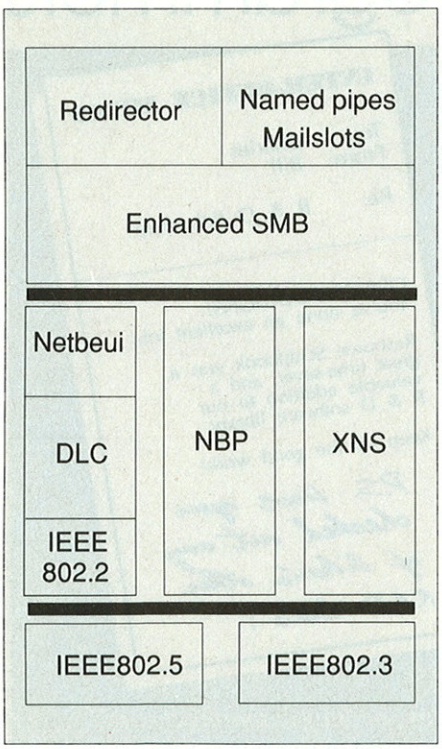

Figure 1 - The Open 3+Open Protocol Stacks

In the future, there will be two similarly-sized competing camps - Netware and LAN Manager

NETBEUI

The NETBEUI/DLC protocol stack is the same as used by IBM in their Token Ring LAN Support Program. If you want to access a server running IBM's LAN Server program (another variant of Microsoft LAN Manager), you must be running DLC on the workstation. In fact, 3Com's DLC runs over Ethernet as well as Token Ring, and it does use IEEE802.2.

NBP is designed purely and simply as a means of carrying NetBIOS messages, over either Token Ring or Ethernet. It achieves good performance and a low memory overhead, but it is not a 'standard' protocol and will not, therefore, talk to anything other than 3+Open servers and workstations. A similar statement could be made about Novell's IPX protocol, so it is unlikely that NBP will be disadvantaged by not being a standard. The substantial savings in available memory which it offers means that NBP is the protocol to use whenever possible.

NBP is one element of 3Com's Demand Protocol Architecture (DPA). Included in version 1.1 of 3+Open, DPA allows a DOS workstation to use a primary protocol (typically NBP) to communicate with network fileservers. When required (eg to access a UNIX host using TCP/IP), a secondary protocol driver is loaded with a DOS command. When the application which uses this protocol terminates, the protocol may be unloaded with another DOS command.

It is possible to configure an OS/2 workstation or a server to use more than one protocol simultaneously. There is no reason why you could not have a server with both Ethernet and Token Ring cards, running (say) XNS over Ethernet and DLC over Token Ring. However, it does not currently appear to be possible to use a server so configured as a gateway between Ethernet and Token Ring (so that you could for instance access an IBM LAN Server on the Token Ring from an XNS workstation on the Ethernet), in the way one can with a 3+Share or a Novell Netware fileserver.

Different Ethernet or Token Ring adapters are supported using hardware-specific device drivers. There are three styles of driver - DOS workstations running XNS use .SYS

Figure 2 - The LAN Manager protected mode NetBIOS API

NetBIOS	Enumerate NetBIOS drivers in this station
NetBIOSGetInfo	Get information about a specific NetBIOS driver
NetBIOSOpen	Prepare to use a NetBIOS driver
NetBIOSClose	Cease using a NetBIOS Control Block (NCB) to a NetBIOS driver
NetBIOSSubmit	Pass a NetBIOS Control Block (NCB) to a NetBIOS Driver

drivers (the same drivers used in 3Com's 3+Share operating system), while DOS workstations running other protocols use .DOS drivers, and OS/2 workstations and fileservers use .OS2 drivers regardless of what protocols are in use. The last two types of driver are written to Microsoft's Network Driver Interface Specification (NDIS). There is full support for the IBM Token Ring adapters, and for 3Com's range of Token Ring and Ethernet adapters (except that there are no NDIS drivers for the TokenLink Plus, and there is no DOS NDIS driver for the Etherlink Plus card).

Initially, an Etherlink Plus was used in our fileserver, but problems were experienced trying to use NBP, and also when listing large graphics files to a laser printer. Changing to an Etherlink II card fixed both problems, so it appears there may be a bug in the Etherlink Plus OS/2 NDIS driver.

Western Digital are known to be working on NDIS drivers for their popular WD8003 Ethernet card, and a number of other manufacturers have said they will provide NDIS drivers for their own cards. What's missing (not surprisingly) is a commitment by Novell to provide NDIS drivers for their NE1000 card. There are several cheap Taiwanese clones of this card, and NDIS support under DOS would enable a very cost-effective DOS LAN Manager workstation configuration to be put together.

Protocols which will be provided for 3+Open in the future include TCP/IP and ISO. The former will allow some degree of integration with UNIX hosts on the same LAN, probably including terminal emulation and file transfer. Using a UNIX host as a LAN Manager fileserver will be possible with a forthcoming Microsoft/3Com/HP product called LM/X.

More interesting in the long term is the possibility of running an ISO protocol stack - specifically, using the ISO Transport Protocol Class 4 (TP4) and lower level protocols beneath a NetBIOS interface. (Transport is the fourth layer in the OSI reference model, and Class 4 provides the most reliable and complete Transport Service). The advantage of ISO protocols is that they will eventually be adopted by most computer manufacturers, enabling you to buy the best machine for the job in the knowledge that it will communicate with your existing equipment.

Unfortunately things are not quite as simple as this. LANs are inherently 'connectionless', and it is relatively simple to implement protocols which use datagrams over them. In America, such connectionless protocols have long been used over wide area networks, whereas in Europe the widespread use of connection-oriented protocols such as X.25 has given a different aspect to WANs. As a result, the approach to establishing connection-oriented services across a LAN is different on either side of the Atlantic. In Europe, connection-oriented protocols are introduced at the ISO Network layer (layer 3), with the result that only a minimal Transport layer (Transport Protocol Class 0 or TP0) is required. In the USA, the Network layer is connectionless, so they have to run TP4 which is a full connection-oriented transport protocol.

NBP is designed purely and simply as a means of carrying NETBIOS messages, over either Token Ring or Ethernet

That both of these approaches fall within the ISO standards is typical of the compromises which go on in the standards bodies. What all this means is that 3Com's commitment to providing TP4 is largely irrelevant in Europe - what 3Com need to do to enable them to tender 3+Open in response to procurements which specify OSI compatibility (eg public-sector procurements which reference GOSIP) is to offer the Connection-Oriented Network Service (CONS), with effectively a null Transport layer.

APIs

LAN Manager provides three general classes of APIs to applications: the protected-mode NetBIOS API, the Inter-Process Communications API (comprising Named Pipes and Mailslots) and the Workstation functions API.

Protect-mode NetBIOS is very similar to its well-known DOS counterpart. There are five API calls, shown in Figure 2. Several different NetBIOS drivers may be available if a machine is running more than one protocol stack, and many different application programs may access the NetBIOS without conflict with each other or with the LAN Manager, which also uses NetBIOS. This is unlike the situation in MS-DOS, where it is possible for an application to hang up the sessions and delete the NetBIOS names used by the network software.

An application must open a NetBIOS driver prior to use, requesting Regular, Privileged or Exclusive access. Any number of applications may open a NetBIOS driver in regular mode, but they may not issue Reset,

DosMakeNmPipe	Create (an instance of) a named pipe
DosQNmPipeInfo	Return information about a named pipe
DosConnectNmPipe	Wait for a client process to open this pipe
DosDisconnectNmPipe	Force an open pipe closed
DosQNmpHandState	Get named pipe status
DosSetNmpHandState	Change named pipe status
DosPeekNmPipe	Read data without removing it from pipe
DosTransactNmPipe	Perform a write then a read on a named pipe
DosCallNmPipe	Equivalent to DosOpen, DosTransactNmPipe, DosClose
DosWaitNmPipe	Wait for availability of a named pipe
DosQNmPipeSemState	Return info on a named pipe associated with a semaphore
DosSetNmPipeSem	Associate a semaphore with a named pipe

Figure 3 - The Named Pipe API

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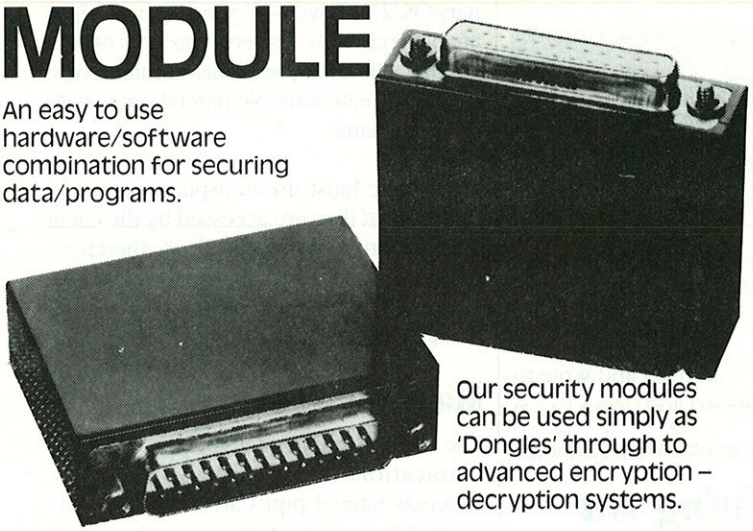

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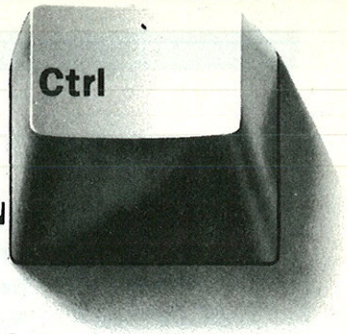

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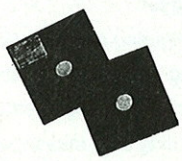

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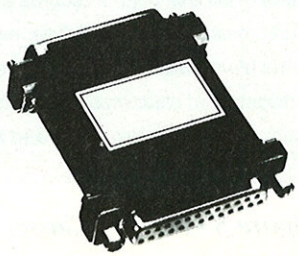

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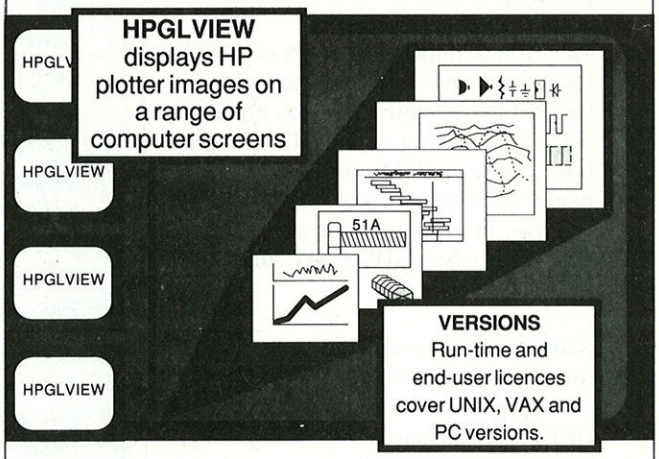

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Figure 4 - The LAN Manager Mailslot API

DosMakeMailslot	Create a Mailslot
DosDeleteMailslot	Delete a mailslot, destroying any unread messages
DosMailslotInfo	Get configuration and status information on a mailslot
DosReadMailslot	Read the next message from a mailslot
DosWriteMailslot	Send a message to a specified mailslot

Receive Broadcast Datagram or Receive Any-Any NCBs, nor may they use the permanent node name. Privileged access will allow Receive Broadcast Datagram and the use of the permanent node name, while Exclusive access allows any NetBIOS operation on the driver. Only two applications can open the NetBIOS driver in Privileged mode (in addition to any Regular mode opens), but an attempt to open it in Exclusive mode will only succeed if no other application has the driver open in any mode. Clearly, Exclusive mode access will not be possible if LAN Manager already has the NetBIOS driver open.

A NetBIOS driver also provides a NetBIOS service to applications running in the DOS compatibility box. (If you have more than one NetBIOS driver loaded, the DOS box gets access to the first driver only.) Initially, with the 1.0 system that I used, a problem with running NetBIOS applications in the DOS box was that they appeared only to have Regular access to the NetBIOS. However, a copy of 3+Open version 1.1 which I was subsequently given did not have this problem.

The Protected-mode NetBIOS is provided for two reasons - as a convenient interface for SMB to use, and as an easy and cheap way of converting existing DOS applications using NetBIOS to OS/2 protected mode. Microsoft are keen that, wherever possible, new applications are written instead to their Named Pipe API, summarised in Figure 3.

Named pipes provide a 'virtual circuit' between two processes, which may either be in the same machine or in different machines on the same network. Typically, a 'server' process creates a named pipe (using `DosMakeNmPipe`), and then waits (using `DosConnectNmPipe`) for a client process to open it. The server process must be running on a fileserver if the client is on a different machine, but if both server and client are on the same machine, only the named pipe DLL is required, and the LAN software is not used at all. A client process will open the named pipe using `DosOpen`, specifying a name like `\\BIGSRVR\PIPE\MYPIPE`, where `\\BIGSRVR` is the name of the machine running the process which created the pipe, and `\PIPE\MYPIPE` is the name of the pipe itself.

The client can then read from and write to the pipe using `DosRead` and `DosWrite` (or their Async variants), and when it has finished it will close the pipe using `DosClose`, making it available for use again by another client. (Note that, unlike ordinary OS/2 'anonymous' pipes, named pipes are bidirectional). If a server process wishes to cope with multiple clients simultaneously, it can create multiple named pipes with the same name.

One of the most useful aspects of named pipes is that they are accessed by the client just like an ordinary file. It is, therefore, possible for the client process to be a program running on an ordinary DOS machine.

Specifying an asterisk will broadcast the message to all mailslots

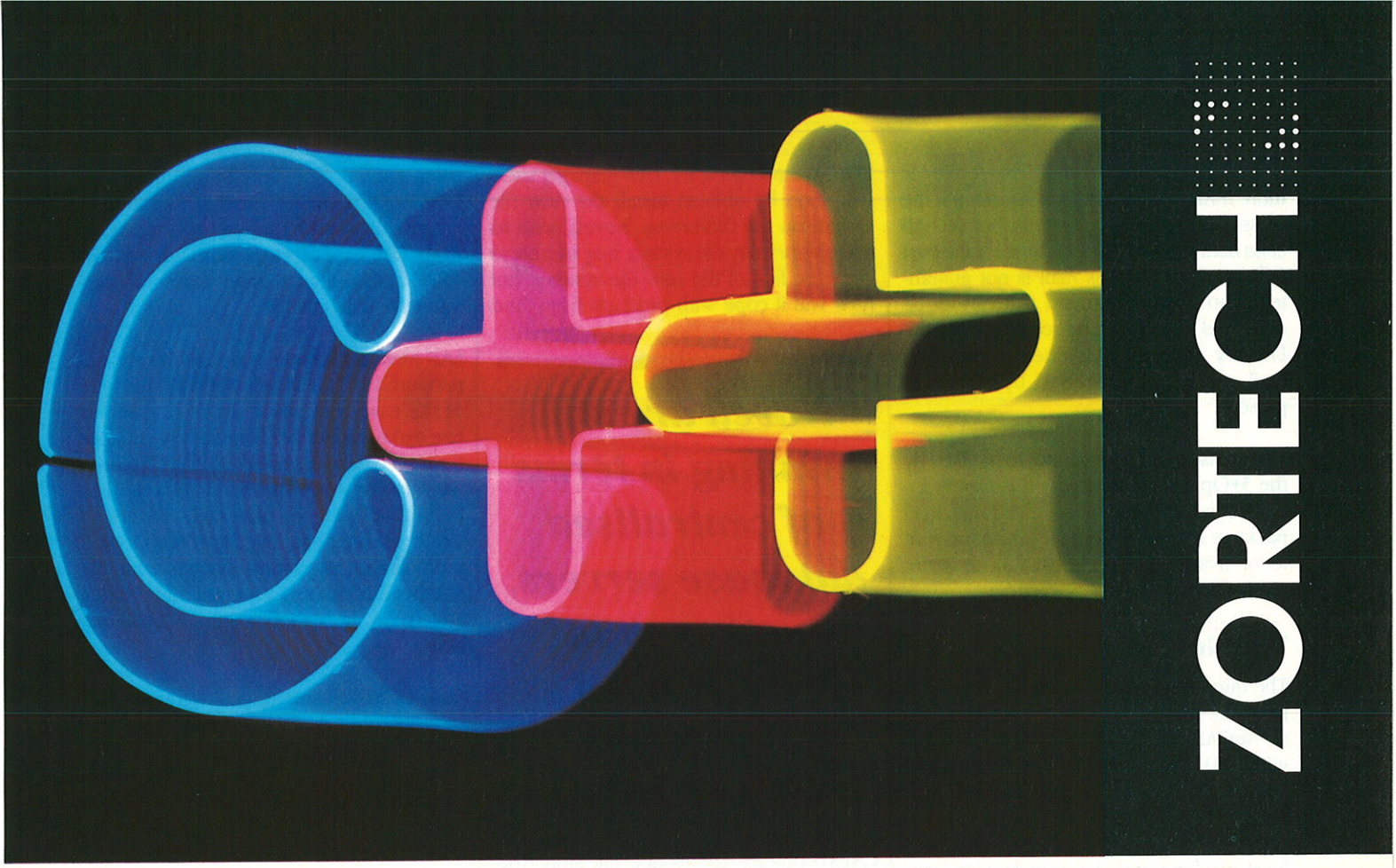
Mailslots

The other significant inter-process communications mechanism is Mailslots. Whereas named pipes are (as their name suggests) a connection-oriented service, Mailslots are connectionless. The mailslot API is listed in Figure 4. A call to `DosMakeMailslot` creates a mailslot with a name such as `\MAILSLOT\INTRAY`, to which a mail message can be sent by another process using `DosWriteMailslot`. If the sending process is in a different machine, it must as usual prepend the destination machine name.

Specifying an asterisk as the destination machine name will broadcast the message to all mailslots. Mail messages can be sent

Class :	Used for :
Workstation	Configuring a workstation
Use	Using and un-using network resources
Messaging	Sending messages between users
Alert	Handling alert messages within a program
Profile	Creating and loading LAN Manager profiles
Config	Obtaining information from LANMAN.INI file
Service	Controlling network service programs
Server	Configuring a server
Shares	Resource sharing by a server
Sessions	Enquiring about SMB sessions to a server
Connections	Manipulating connections within a session
Files	Controlling files open over a session
Auditing	Manipulating the audit trail
Error Logging	Manipulating the error log file
Character Devices	Controlling serial devices and their queues
Print Queues	Manipulating printer queues
Print Jobs	Controlling the jobs within printer queues
Print Destinations	Controlling the physical ports used by print queues
Access	Control of access control records at a server
Group	Control of user groups and their membership
User	Control of user accounts on a server
Statistics	Interrogate and clear machine statistics
Remote	Access to remote copy, move and run facilities

Figure 5 - Net API Classes



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first class or second class. The former is more reliable (the sender is informed if the message fails to be delivered), but second class mail is faster (a lesson here for the Post Office?). Second class mail is not guaranteed (no error is returned if it cannot be delivered), but it can be received over the LAN by workstations, whereas first-class mail can only be received by servers at present.

The mailslot API appears not to be used by the 3+Open user interface. It is clearly intended as a basis for an electronic mail package but, because mail cannot be sent to or from a DOS workstation, it is not particularly useful at present.

The Net API

The third class of API which LAN Manager provides is the workstation functions API, or 'Net' API (because most of the calls start with Net). There are over 100 of these, and Figure 5 summarises the groups into which they fall. They provide programs with full access to the LAN Manager services at the local machine and at a remote fileserver, although some of the API calls require the workstation to be logged in as an Admin user in the latter case. The completeness of the Net API may be judged from the fact that the NET program (both in its command-line mode of use and in its full-screen mode) is written entirely to this API. All three classes of API are described in detail in the Microsoft LAN Manager Developer's Guide, included with OS/2 Software Developer's Kit.

Netware vs 3+Open

Novell Netware is very much a mature product now, having been around for well over five years. In that time, it has acquired more and more functionality, making it one of the most sophisticated LAN operating systems available. LAN Manager on the other hand, although starting from a base of great flexibility, has not yet had the time to accrue a number of the features which Netware now possesses. In particular, fault tolerance is one major area where Netware can out-perform LAN Manager. Another is the ability in later versions of Netware to restrict the amount of server disk space available to individual users.

There are points in LAN Manager's favour right now, such as the facility to limit the number of simultaneous users of a resource, and the ability to use multiple protocols. However, much of the interest it has generated centres round LAN Manager's future development and its place in Microsoft's and IBM's strategy. For instance, Microsoft has added the High Performance File System to OS/2 1.2. LAN Manager users will soon be able to install the new file system on the fileservers. Novell, with its own proprietary file system, may be able to copy the first of the new file systems, but how will it cope with products from third parties, perhaps offering built-in ISAM or CAFS (Contents Addressable File Store) features? Novell have shown that they are aware of the problem by announcing support within their Netware 386 product for their own flavour of installable file system. However, it seems unlikely that they will be able to use Microsoft-compatible systems.

Novell are still thinking in terms of centralised database servers, rather than distributed databases

The main advantages of LAN Manager will become apparent over the next two years or so, as distributed data processing gains acceptance. At present, we tend to think of a network as being simply the means to reach a fileserver. This is really a return to the old concept of centralised computing - data is still held centrally although processing power has migrated to the user's desk. True distributed data processing involves keeping the data on the users' machines too.

In a company with a number of PCs which are not networked, you would expect to find the accounts database on the PC in the accounts office, and the stock control database in the storeroom PC. Installing a LAN should not require both databases to be moved to a single fileserver which acts as a bottleneck and increases vulnerability. The function of the LAN should be to allow any PC (subject of course to authorisation controls) to access either or both databases as required by the user. Database server technology is the key to providing this capability.

Microsoft's SQL Server looks like becoming the industry- standard database server package. It runs on LAN Manager servers, using named pipes to communicate with DOS or OS/2 clients. Another very important program which runs on LAN Manager is IBM's Database Services, although this uses APPC rather than named pipes to communicate with clients.

LAN Manager is better suited to this style of networking than Novell Netware, because of the ease with which an OS/2 machine can make its data available to workstations through database server software. To offer the same degree of flexibility, Novell need to be able to run the fileserver software on OS/2 workstations. Netware is already a multitasking operating system, and the overhead of running a second multitasking system on the same machine is considerable.

Initially, Novell announced two alternative strategies for dealing with the problem. They planned to develop an 80286-based co-processor board running OS/2 which would sit in a Novell fileserver and run a database server program of the user's choice. Secondly, they announced that Netware would be available as a task running under OS/2.

There does not seem to be much action (or even talk) about the co-processor option, and most people would not be surprised if it were quietly dropped. Netware for OS/2 looks more likely to appear as a Novell product, but Novell have themselves admitted that its performance will be inferior to their existing versions of Netware.

Now however, Novell have started talking about a third option - providing a third-party database server which runs under Netware directly. Fox Software are to produce an SQL database server to run under Netware and talk to AT/Microsoft client front-ends using named pipes. (Novell plan to emulate named pipes, just as they have emulated DOS NetBIOS. It is unclear whether they will also emulate Mailslots, protected-mode NetBIOS, or other APIs such as network semaphores which Microsoft may introduce.)

It is clear that Novell are still thinking in terms of centralised database servers, rather than the distributed database concepts which LAN Manager makes possible. Although LAN Manager has some catching up to do in areas like fault tolerance, it does offer present and future advantages to DOS and particularly OS/2 workstations.

Conclusions

Throughout this series of articles I've been talking interchangeably about LAN Man-

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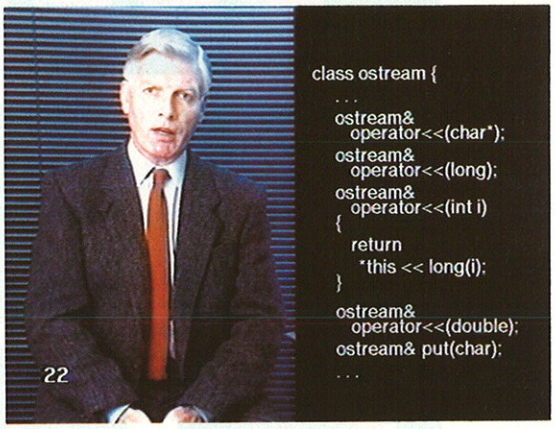

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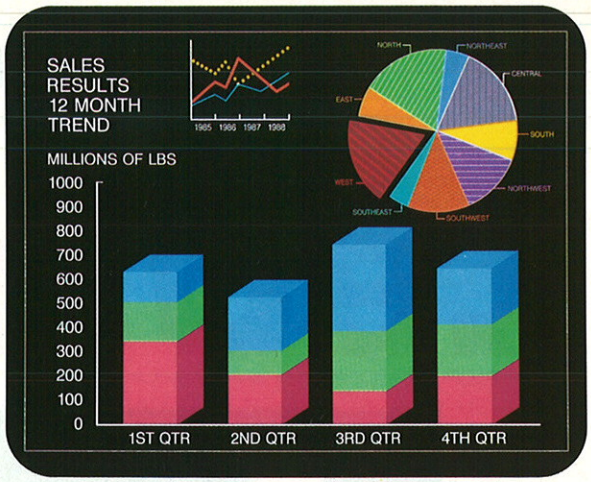

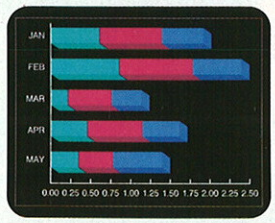

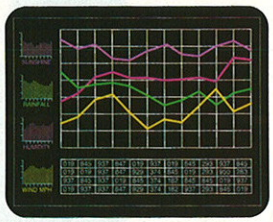

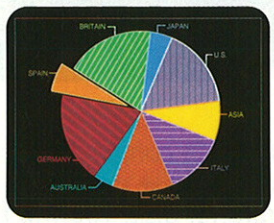

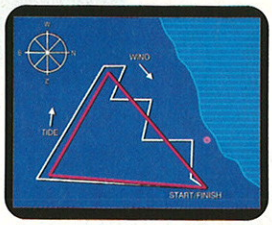

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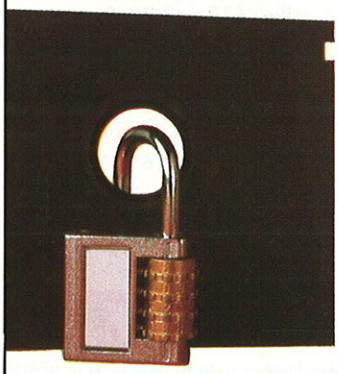

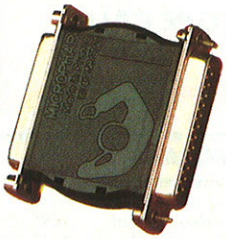

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ager and 3+Open. 3Com were involved in the development of LAN Manager, so it does not make sense to ask 'which bits of 3+Open are 3Com and which are Microsoft?'.

We can, though, ask what 3Com have added to LAN Manager to create 3+Open. It is difficult to tell, but by considering various clues scattered around, it seems clear that the only major additional feature of 3+Open is the provision of the XNS protocol stack with its capability for interworking with 3Com's older 3+Share operating system.

The backup software for 3Com's 3S401/2 dedicated servers is clearly also 3Com specific. As one might expect, therefore, the current version of 3+Open is LAN Manager in a fairly raw form.

It's difficult to tell with a 5-user system, but performance seems to be at least as good as Netware. Benchmark tests by the American company Neal Nelson indicated that LAN Manager performed substantially better than Netware in applications benchmarks, particularly for OS/2 applications. There are still several rough edges which will need to be smoothed over in the next version of 3+Open, and the manuals could do with an overhaul.

It is possible to configure an OS/2 workstation or a server to use more than one protocol simultaneously

Companies which are committed to implementing OS/2 will need to consider very carefully whether sacrificing the present advantages and future potential of 3+Open in order to stay with the current market leader is worthwhile. Even if your organisation prefers to stay with DOS for the time being, you should consider whether the sophisticated access control facilities of 3+Open might perhaps suit your needs better than Netware. If you already run Novell, Interlan sell a package which lets a Netware client access a file server based on LAN Manager.

Response

Clearly, Novell will respond to the challenge posed by LAN Manager, but it seems likely that Netware will lose its total dominance of the market. In the future, there will be two similarly-sized competing camps - Netware and LAN Manager.

The bottom line is: will I be recommending 3+Open to my users? The answer is a definite yes. However, I will suggest that, if possible, they should wait until the release of version 2.0 eliminates some of the rougher edges.

Chris Adie is with the Computing Service of Edinburgh University. The current version of 3+Open is 1.1. Version 2 has recently been announced, and 3Com expect it to ship in July.

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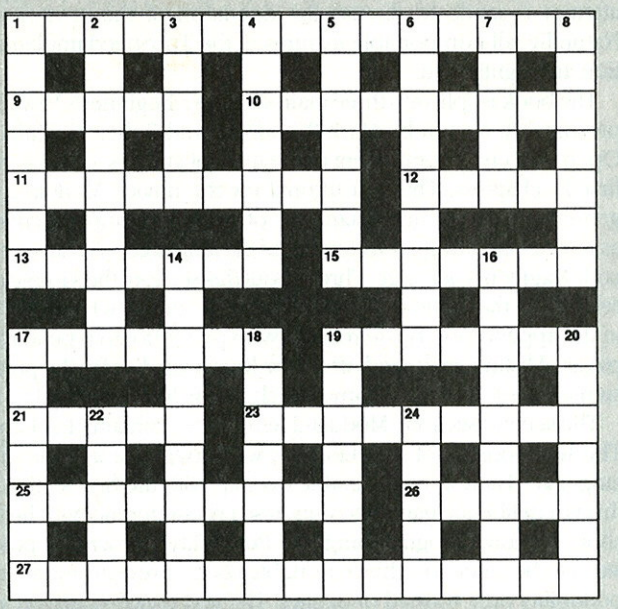

ACROSS

1 Going firmly along the IT road (15)
9 Negative is Eastern confusing signal (5)
10 Such a system may be working in the theatre (9)
11 Esso vibes may become one track minded (9)
12 Single numeric character with an old finger (5)
13 Weaning away the god's charge (7)
15 Beginning to make two oriental signs (7)
17 Such 9 or output may need a 25 (7)
19 Messes around Edward's little fruit (7)
21 Place for a battle in a file (5)
23 Usually turn into the right floating point form ... (9)
25 ... and take out or use a fan (9)
26 Paperware to help the card go straight (5)
27 21 many programmers hope to enter (7,8)

DOWN

1 Cheer up the operator's desk (7)
2 RAM, for instance, where most are in confusion (4,5)
3 IT's most important people (5)
4 Eastern movement not yet shown by an IT system (7)
5 Lettuce cold and mostly hidden (7)
6 Gave up on a fearsome MS-DOS prompt (9)
7 Bonus covering 5? (5)
8 Cancels logic circuits from Tyneside (7)
14 2 gives you such access (9)
16 What someone in 27 does (9)
17 Sticky treats (7)
18 Some people go to any, fixed or not (7)
19 Classical language with arrays as the only structure (7)
20 60s group carrying out a search? (7)
22 Crazy feats of the community's competitor (5)
24 Europe's answer to 19 (5)

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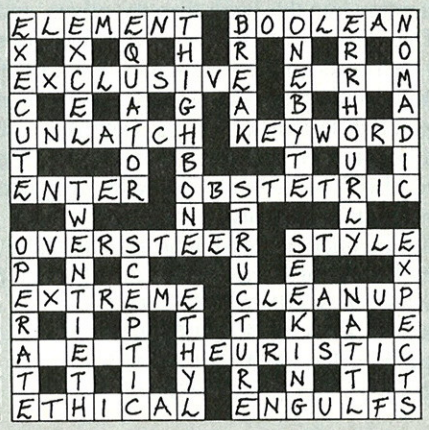

Books

This month, we delve into the offical Phoenix guides to the PC BIOSes and look at a new Modula-2 book.

System BIOS for IBM PC/XT/AT Computers and Compatibles
CBIOS for IBM PS/2 Computers and Compatibles
ABIOS for IBM PS/2 Computers and Compatibles

One would expect that these books, coming from the major source of BIOSes for 'clone' machines, would largely be a reprint of their internal specifications and, as such, would be accurate and definitive. Sadly, this does not appear to be the case. Allowing for the (admittedly few) typographical errors that have crept in, and the apparent confusion on the part of the authors as to whether the books are aimed at beginners or specialists, I feel that they are far from definitive. In my opinion, it is essential to have other reference works to hand and, ideally, an example BIOS source, before serious work is undertaken. The books on the System BIOS and the CBIOS (the PS/2 real-mode 'compatibility' BIOS) are almost identical, with the exception of the extra facilities provided by the PS/2 such as password protection on boot.

Both start off with an introduction, list of acronyms, and an overview of the BIOS to be discussed. This is followed by a description of the hardware and a list of what is stored in low memory, CMOS RAM, and (in the case of the PS/2) the extended data area in high memory. Both books then continue, predictably, with descriptions of the keyboard and video service routines, distinct chapters for floppy and hard-disc services, followed by serial communications support and so on. To the authors' credit, each chapter also contains a listing of memory usage and hardware devices appropriate to the service discussed, which saves a lot of hunting around for related information.

The PS/2 ABIOS book is a different matter altogether, if only because in this case it is one of the first in the field. Like the other two, it starts off with introduction, acronyms, overview, and hardware environment. Then it examines data structures used by the ABIOS, initialisation, calling conventions and ABIOS extensions. This is extremely meaty stuff. Like the other books, it goes on to deal with the various device types and services but here, everything is new and will be unfamiliar to the vast majority of programmers. Each of the device-specific chapters has a detailed overview of the appropriate hardware and modes of operation, a discussion of the device's implementation of the standard ABIOS calls ('Return Logical ID Parameters' etc) followed by a detailed description of the device specific calls. Maybe it's because the information is less familiar, but I feel that the authors have put far more care and attention into this book than the others, and it deserves to be one of the classic reference books in the field. Despite the shortcomings of the books on the System BIOS and CBIOS, these three volumes should find a place on the shelf of anybody responsible for porting operating systems or writing diagnostic software for PC-class machines, as well as those who are simply interested. The book on the ABIOS is essential reading for designers of add-on hardware for the PC, particularly high-performance graphics cards, since they are under increasing pressure to make them compatible with OS/2: and that's what the PS/2 is all about. *Mark Morgan Lloyd.*

System BIOS: ISBN 020 1 51806 6
System CBIOS: ISBN 020 1 51804 X
System ABIOS: ISBN 020 1 51805 8
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Portable Modula-2 Programming

'You can't judge a book by its cover'. Perhaps McGraw-Hill's design department made a *deliberate* decision to give this book as boring a cover as you are likely to find gracing the shelves of your local paperware shop, by way of emphasising its cheap price and good value-for-money. I think this is a mistake, because it may cause many would-be readers to overlook an excellent book.

Portable Modula-2 Programming is both a tutorial and a reference work. The emphasis on portability is maintained by including, at the end of each chapter, a special section discussing portability issues of the language elements just described. You might not think that there was very much to say about portability - common practice is to confine the issue to a two page appendix, just before the list of ASCII characters. The secret of this book is that two of its authors, John Souter and Martin Davies, work in the BSI's Computer Languages department, where the International Standard for Modula-2 was first devised. This is presumably where they acquired their eye for detail. I should also mention another feature common to every chapter: a set of review questions, in standard student text book form. Just the thing for those who like testing themselves. For those who don't like testing themselves, there is also a complete set of answers.

Portability is one thing, but you do need a real-live implementation to compare things with. The authors have chosen JPI's TopSpeed Modula-2 as their reference implementation, though no attempt is made to discuss the operation of the environment. Naturally, all non-portable features of the TopSpeed implementation are highlighted.

The book is split into three main sections. 'Beginner's Modula-2', presumably written by Mark Woodman and Robert Griffiths, the Open University component of the team of authors, consists of the first 11 chapters. This is a tutorial for the novice Modula-2 programmer (but an understanding of programming principles is assumed), covering each element of the language, with at least two code fragments per page. Throughout this section, the sample code references the authors' portable library modules, which are listed in the appendices. Those readers who prefer not to type in the 28 pages of listing, may send off for the library on disk for the princely sum of one formatted floppy, which seems like a fair deal to me.

The second section, 'Modula-2 Reference', contains 12 chapters. The text consists of a detailed trawl through all aspects of the language. There is considerable overlap with the first section, but this is a deliberate gambit to minimise cross-referencing. The third short section, 'Programming for Portability', describes positive steps to be taken to achieve portable code - previous mentions of portability only warned of danger. The text concentrates on areas generally thought to be difficult, such as systems programming and coroutines. The book finishes with four appendices. These consist of a collected syntax of the language in textual and diagrammatic forms, a description of TopSpeed extensions, example implementations of the library modules used in the book, and answers to exercises. *Malcolm Shedden.*

Authors: Woodman, Griffiths, Souter and Davies
Publisher: McGraw-Hill
Price: £14.95
ISBN: 9 780077 072018
Pages: 493

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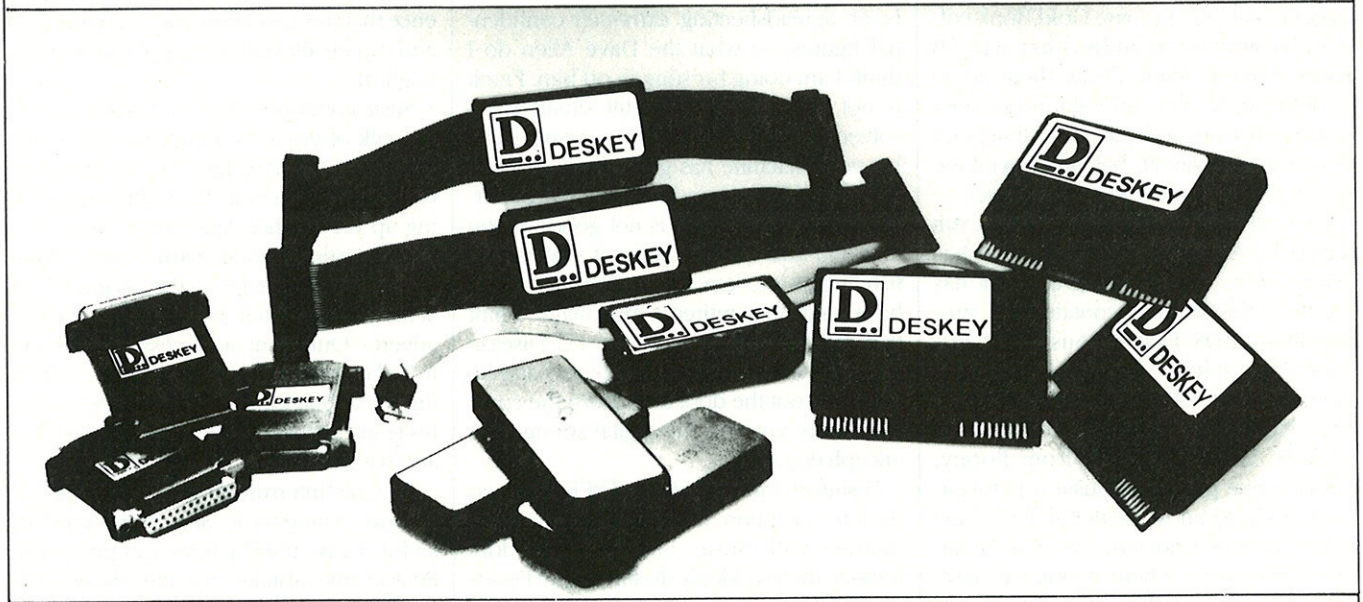

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STOB - Virus!

'The notorious AIDS Information disk appears to have been mailed to several thousand [PC] users... The disk contains the so-called 'Panama Trojan', a dangerous program designed to lock users out of their hard disks' - PC User Magazine

Wake up late. Oh no it's Monday, get up, stagger to kitchen, prepare Gold Bonk coffee and bowl of Marks and Sparks Grade 2B muesli, retch at smell, throw them down loo. Why am I feeling off-colour? Consider bunking off work and watching Blue Peter (or is that Tuesdays?), but need overtime money; resolve to Pull Myself Together.

Reach office at 9.49, feeling shivery. Am greeted by Susie the secretary, who has exciting news. This morning the mail has brought a floppy disk, containing a program about AIDS. Examine Susie's PC, discover Susie's hard disk now harbours read-only AUTOEXEC, hidden directories, REM{\0xFF}.EXE - the whole works.

Reboot Susie's machine from floppy, remove rogue programs. Susie is petulant; how was she to know AIDS disk had virus? Explain that this is not virus, this is a 'Trojan horse'. Ask Susie: where is original AIDS disk. Susie says: she has given it to Frank, the Managing Director, who is trying it out on my AST.

Rush into office to save My Baby. Frank starts like a rabbit, whips off his jacket and throws it over the monitor. Frank shouts he is, er, spreadsheeting *extremely* confidential figures, so what the Dave Allen do I think I am doing bursting in on him. Frank is not being frank. Difficult situation resolved when Susie marches in saying: ha ha ha, your machine has got a virus. Frank is legendary hypochondriac and his understanding of computers is not good - if you told him that PCs ran better if you stuffed fish fingers into 'em, Cap'n Birdseye would have long since retired a millionaire. I hint that machine may have Mad PC Disease (possibly transmittable to humans) and he is bolting out the door and down the corridor before you can say digital spongiform encephalopathy.

Disinfect Victoria with XTREE; then go back to reception, anticipating giggly post mortem with Susie. Susie seems oddly remote, then suddenly dissolves into floods of tears. It transpires that, after Susie had answered its impertinent questions, AIDS program opined that she needn't bother to book a holiday this year. Discrete enquiry reveals main symptom of Susie's ailment. Am able to reassure from First Hand Experience that this condition not invariably fatal, and can be alleviated by application of live yoghurt.

Susie comforted, I return to own den. All this talk of disease reminds me of my own condition. Am now light-headed and feverish, must be hatching 'flu. Cannot face coding up yet another data entry screen. Long for interesting work in warm, sunny climes. Could perhaps get job as Panamanian Virus Writer, must watch job pages of .EXE for advert - 'Our client, a successful and established extortioner, based overseas, is looking for a QuickBASIC programmer to join his team. Generous package includes cigar and hat allowance.'

Reverie interrupted by appearance of fully-recovered Susie. She chirps: you look awful. I say: think I have caught a virus. Realise my mistake instantly. Susie yells: DON'T YOU MEAN A TROJAN HORSE! and collapses in shrieks of mirth.

Abandon struggle and slink home to Blue Peter, defeated.

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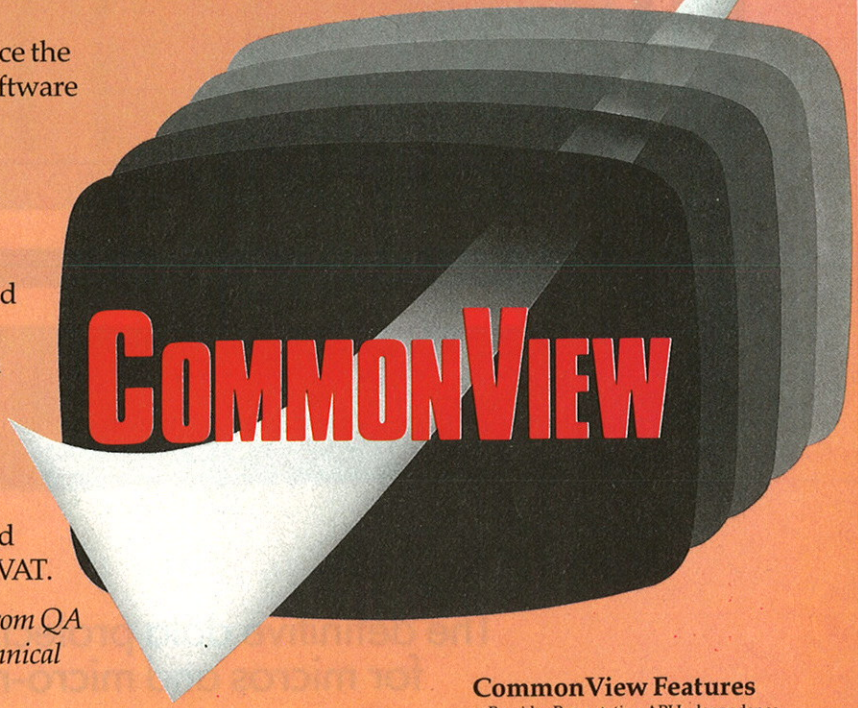

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```
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#INCLUDE EXPERIENCE.H /* 2 YEARS + REQUIRED */
#DEFINE ENVIRONMENT "Development"
#DEFINE PACKAGE "Excellent"
main ()
{
printf ("call now or send cv for early interview/n")
printf ("we meet all relevant candidates/n evenings possible/n")
```

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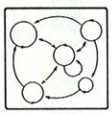

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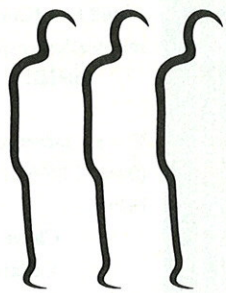

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Our client, Distributed Information Processing Ltd has designed, developed and produced THE IBM-compatible POCKET PC, sold under licence by ATARI, as PORTFOLIO. In response to further demand, DIP are expanding their engineering activities to develop new Pocket PC Technology in keeping with the philosophy of "faster, smaller, and cheaper products".

SOFTWARE ENGINEERS

Guildford ***to £17000***

Young graduates required to design and write application programmes to run on IBM PC compatibles using 'C', 8086 assembler and MS/DOS. Also, engineers to develop PC-compatible BIOS and device drivers in 8086 assembler.

Ref: 132569/jh

SOFTWARE QUALITY ASSURANCE ENGINEER

Guildford ***c £17000***

Design quality control systems by writing software using C and/or 8086 assembler. Contribute to the design of prototype systems to aid quality control during production. Customer support/liaison will be a significant part of this role.

Ref: 134678/jh

If you are interested in a career with this young and vibrant company, please contact Julianne Hull

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London **to £20,000 + benefits**

This is a unique opportunity to join a team of elite PC Support professionals who are supporting over 300 users at one of Londons most prestigious Financial Organisations. The successful candidate will have a sound knowledge of LOTUS 1-2-3, DBase III/IV and Networking.

Surrey **£ negotiable**

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Berks **to £25,000**

This young fast expanding company who specialise only in Data Communications are looking for well qualified Software Professionals. You must have at least 2 years experience in either Pascal of 'C' and enjoy a fast moving environment.

Middlesex **£20,000**

This Post Sales Support position requires a sound knowledge of UNIX and SQL. You will be supporting Informix Software and be working in a small highly motivated team.

London **to £20,000**

This London based International company require a UNIX Systems Administrator, to provide technical support and assistance to their UK offices, this includes technical advice and support in respect of all applications running on both the UNIX operating system and PCs. You will have at least 2 years experience of UNIX and the ability to communicate with non-technical users.

For further information, please telephone Allison Barnard on 048649 595 or evenings on 048649 780 or send your CV to 6 The Mews, The Common, Dunsford, Surrey GU8 4LJ or Fax to 048649 739

CRISIS - WHAT CRISIS?

Everyone acknowledges the skills shortage in computing. But is it really a problem?

'Dear Sir, I read with interest your recent article about the skills crisis in the computing industry and am mystified. Last year, my son completed a full-time structured programming course at the local poly and, despite writing to over a hundred companies in our area, he has not been offered a single interview. It is beyond me that .... etc....'

I am sure you must have seen this type of letter to computer publications from time to time and it is easy to understand the correspondent's confusion. I often wish that an editor would reply, 'Well, there isn't really a crisis at all', but this would make him look foolish for commissioning the article in the first place.

Young Johnny's difficulty in finding a job is one of a number of paradoxes pertaining to computing and personnel (or 'Human Resources' as some go-ahead firms like to call it). Also there are many people who are overpaid and not very good at their job, who actually register with agencies in order to find a better one. The less-brave among us offer to 'keep them on file', There are some veritable diamonds who beaver away at far less than their worth. This group is, unfortunately, far smaller than the former. A programmer possessing the odd GCE and who might have three years' commercial experience, is of more value to most companies than a raw computer science graduate. Of course, these anomalies are not unique to our industry, but they are, however, far more prevalent.

There are two reasons for this. Both stem, I feel, from the relative youth of computing. New products hit the market every week. Successful demo is followed by purchase, but often, the substantial support offered, whether forthcoming or not, is not enough to run that product effectively without in-house expertise. This has to be bought in quickly through contractors or overpaid permanents. Second, despite almost every business in the country owning a computer of one sort or another, there remains a misplaced mystique (and fear) about what makes them go. The NCC's January 1990 Staff and Salary Survey tells us that the ratio of IT to non-IT personnel in typical large companies is 1.65:100. To further ensure that the 100 don't find out too much about what the 1.65 are up to, we invent jargonistic terms which often mean the same thing such as IT, MIS and DP.

I would like to think that open systems technology and other standardisation initiatives will help to increase a broad-based understanding of the technicalities of computers and a realisation that anyone with a good understanding of a core technology can adapt and be productive very quickly in a new environment. Unfortunately, the signs are not encouraging. Despite a healthy demand for UNIX skills, in the past 12 months, I have had a number of candidates, with substantial training in UNIX, turned down for interviews due to lack of hands-on experience and no-one can get hands-on experience unless they have a job.

The fact is that we in the mainstream of the computing industry are looking after our own interests. Technical people, training people, recruiters and publishers all feed off the skills shortage and there is a general reluctance to kill our goose.

Mike Paterson runs UK Appointments, which specialises in finding UK-based work for applicants from abroad. He can be contacted on 01 994 1854.

'C' PROGRAMMERS

Advanced System Architectures is a company enjoying international renown for its development of technologies and techniques for systems requiring massive computational resources.

ASA is now increasing its system simulation capability to support recent contract awards, and has vacancies for versatile 'C' Programmers to join this team. The successful applicants will be highly conversant with the application of 'C' to time critical applications, and ideally will have some familiarity with simulation systems. The work will be carried out on a distributed Unix environment of Sun workstations backed-up by an Encore 'number cruncher'. Opportunities for working in Ada are also available for programmers who wish to broaden their experience.

In addition to above average salaries all employees of the company enjoy permanent health insurance, private medical cover, a share option scheme, a contracted-out personal pension scheme and life insurance cover. The company is located in very attractive offices adjoining the Alice Holt forest on the Surrey/Hants border.

For further details please contact:

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Technical Authors to £22K: The most essential skills are good command of spoken and written English and an understanding of technical documentation. An ability to describe user interfaces is also an essential requirement of this expanding international Company.

BERKS

Software Development Engineer—to £20K: You should have a minimum of 2 years experience in Macro programming and VAX/VMS systems services for this Research and Development Company. Additional experience of Networking Systems such as TCP/IP or Decnet would be a distinct advantage.

Senior Software Engineer—Neg: An opportunity to develop your career within this electronic systems Company in the supervision of a small team with the opportunity of short European trips. A minimum of 4 years experience in an IBM PC environment using C language is the bottom line. One or more of the following is a plus, real-time, multi-user applications, database design and networking.

HERTS

Technical Author—Neg: This expanding software house specialising in service and products to the international banking sector want a Technical Author to compile and maintain system specifications to a high standard together with other tasks such, as verification of documentation upgrades by hands on experience.

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Personal qualities will include excellent presentation, motivation and initiative. Career possibilities are excellent.

'C' PROGRAMMER/ANALYSTS

City **To £22k Package + Banking Benefits**

The team developing transaction processing systems within an international investment bank require additional PROGRAMMER/ANALYSTS with excellent 'C' programming skills. In addition to 1 year's experience of 'C' under UNIX or VMS, you should also be a good communicator and have the ability to understand complex business practices. Training into RDBMS is available for those who can rise to this challenge.

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SOFTWARE DEVELOPMENT To £25k + Car

As a member of the development team you will contribute to providing quality software products for use in all of our markets. The major product development areas include:

✳UNIX ✳NETWORKING ✳GRAPHICS ✳SYSTEM APPLICATIONS

With a minimum of three years' commercial experience, your skills will include in-depth expertise in one of the following:

✳UNIX ✳VMS ✳X-WINDOWS ✳ASSEMBLER ✳'C'

POST SALES SUPPORT To £25k + Car

As a member of the Technical Support Group, you will provide expert advice on all aspects of post sales activity to OEMs, VARs and distributors. With at least two years' experience in development or support of UNIX, your skills will include one or more of the following:

✳'C' ✳NETWORKING ✳DEVICE DRIVERS ✳KERNEL CONFIGURATION ✳X-WINDOWS ✳DATABASES

Whether you see your career developing as a technical specialist or project manager, career opportunities in this expanding team are second to none.

TECHNICAL CONSULTANCY To £30k + Car

Your role will be to provide expert technical advice to major computer manufacturers liaising with product development and support teams to advise on the effective integration of our products. With at least three years' experience in a development or post sales role with a manufacturer, VAR or developer in a UNIX environment, your technical skills will include one or more of the following:

✳UNIX ✳KERNEL CONFIGURATION ✳NETWORKING ✳X-WINDOWS

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BANKING WITH INTERNATIONAL TRAVEL
City to £30,000 + banking benefits

COMPANY: One of the **world's** leading **International Banks** committed to IT development in the process of expanding its DP department.
POSITION: Senior Analyst/Programmer to **design** and **develop realtime dealing systems**, using **'C'** and **'C'++** initially on networked using PCs migrating to **UNIX**.
SKILLS: 3 years design/development experience using **'C'** in a **UNIX** or **PC** environment. Knowledge of Capital Markets would be advantageous, but not essential.
OTHER: Superb career prospects coupled with the **latest technology.** Opportunities for **international travel.**

'C' - MOVE INTO BANKING
City to £19,000 + banking benefits

COMPANY: One of the **world's premier banking groups**, currently employing 61,000 people in the UK with over **2,000** in IT in central London alone.
POSITION: Analyst Programmers within a department currently developing systems using **'C'** under MSDOS, at present carrying out **UNIX** feasibility study.
SKILLS: 12 months minimum 'C' experience gained in either a **UNIX** or **MSDOS** environment. Previous finance experience and advantage.
OTHER: Excellent career prospects. Benefits include **guaranteed bonus, profit share** etc.

RETRAIN ORACLE/INFORMIX
City to £25,000 + benefits

COMPANY: Open systems **consultancy** and **software house** with a turnover of **£8m+**, employing over **130 staff.** Expanding Blue Chip client list both within the UK and abroad.
POSITIONS: Analyst Programmer, and Support Analyst to work within a team developing and supporting **UNIX** based systems.
SKILLS: Analyst Programmers, 2 years minimum experience using **'C'** and any **4GL/SQL** under **UNIX.** Support Consultants should have at least 4 years similar experience.
OTHER: Excellent opportunity to join a market leader, willing to retrain in **ORACLE** or **INFORMIX.**

STATE OF THE ART - DEVELOPMENT
Herts/City to £20,000 + bonus + benefits

COMPANY: young and expanding Systems House. Recently won a **prestigious contract** to develop a bespoke system for a City based Merchant Bank.
POSITIONS: Programmers/Analyst Programmers to work using **UNIX/'C'** and **C++.** Training available in Graphics, 4GL/Relational databases, communications, windowing, expert systems and object-orientated programming.
SKILLS: Graduates with at least one year's **'C'** or **C++** experience under **UNIX.**
OTHER: First class training with a superb salary package for the right candidates.

UNIX, 'C' BROADEN YOUR HORIZONS
West London to £20,000 + benefits

COMPANY: Highly successful British Plc. A high profile organisation with truly **International** representation.
POSITIONS: Programmers to Senior Analyst Programmers to develop/object orientated systems using **UNIX, 'C'** and **INFORMIX.**
SKILLS: One year plus **'C'** and **UNIX** gained in **any** environment. Structured analysis/design skills and advantage particularly more senior roles.
OTHER: Technically highly progressive company - extensive user of **CASE** and **A.I.** Excellent package includes **Heavily subsidised Air Travel.**

PC DEVELOPERS
Berkshire £11-20,000

COMPANY: UK base of one of the largest electronics/computer organisations in the world.
POSITIONS: **Programmers** and **Analyst Programmers** to work on the development and support of a wide range of office systems.
SKILLS: Good all round technical skills gained in any PC environment. At least 1 year's experience of **C.**
OTHER: Opportunity to join an expanding group within a technically advanced and challenging organisation.

'C' ANALYST PROGRAMMER
City £16-20,000 + mort

COMPANY: Leading Investment Banking Group providing financial and advisory services on a worldwide basis through an international network of offices.
POSITION: Analyst Programmer working on a range of systems in a progressive front-office environment.
SKILLS: Knowledge of IBM PCs with 'C' programmer skills and the ability to deal effectively with users.
OTHER: Excellent opportunities await talented 'C' programmers in this dynamic financial organisation.

PC NETWORK
West London £18-24,000

COMPANY: One of the largest most successful **Retail Organisations** in the world. Prestigious West London location.
POSITIONS: **Networking Specialist** to work as part of a Team designing and implementing PC networks.
SKILL: Solid experience of LAN Technology (Novell), **C** development/support, and ability to liaise with users at all levels.
OTHER: The successful candidate will find this a challenging position in a technically progressive environment. Renumeration benefits are excellent.

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POSITIONS: Analysts, Programmers and PC Support Specialists to provide effective PC-based solutions from design to implementation.
SKILLS: Good all-round PC experience including knowledge of **Database, Spreadsheets** and ideally **Networking** and **Comms.** Additionally strong interpersonal skills essential.
OTHER: Many challenging opportunities exist to develop your career in technically stimulating environments.

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Ref: MJ/64

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Ref: MJ/63

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Ref: MJ/57

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SOFTWARE ENGINEERS
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ADA	Fortran
UNIX/C	4GL's

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If you are currently working in a UNIX support role and are looking for the rewards you know you truly deserve then look no further. This leading manufacturer and systems house is looking for UNIX professionals with expertise in one of the following areas:

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COMMUNICATIONS
4GLs-RELATIONAL DATABASES

Excellent communication and presentation skills are essential. In return for your expertise you will be joining an elite team of UNIX professionals in a company that has been growing at 70% p.a. for the past 2 years.

INFORMIX/UNIFY
Support and Development
London, Home Counties
to £25,000 + Car + Bonus

This leading systems and software house is looking for committed professionals with at least 6 months experience in one of the above relational databases. A knowledge of UNIX is essential and any exposure to office automation/accounting packages would be useful. Opportunities exist in Pre/Post Sales and Development.
Telephone or write with a full CV.

MBA
Recruitment Consultants
Michael Bailey Associates Ltd.

For more information please contact:
Michael Garlick on *01 250 1234 / 01 523 2821*
or write with a full CV to:
Michael Bailey Associates Ltd,
Rococo House, 281 City Road,
London EC1V 1LA
quoting reference EXE/01
***Fax:* 01 253 6664**

OPEN SYSTEMS.....
.....OPEN DOORS

JOHN BROWN ASSOCIATES is a Computer Recruitment Consultancy. Our specialisation is the recruitment of professionals conversant with the working environments of UNIX, DOS and their related software products, tools and techniques.

Below are a sample of the type of positions we have available. If you would like more information on them or others we currently have available, make a note of the telephone number stated below and give us a call to discuss job opportunities.

C++/UNIX DEVELOPMENT
Hertfordshire - to £20,000

A small but rapidly growing Systems House urgently requires graduate calibre programming professionals who are keen to develop expertise in Object Orientated Programming, Windows, Expert Systems and Graphics.

To qualify you must have at least 12 months programming experience within a 'C'/UNIX environment. (Preference will be given to candidates currently utilising C++, however full training will be provided.)

UNIX SYSTEMS DEVELOPMENT & TECHNICAL CONSULTANCY
London - to £30,000

This market leader in Open Systems Consultancy needs torecruit individuals with commitment to OSI.

The successful candidates will be commercially aware graduates who have significant industry exposure and excellent C programming skills, working knowledge of the UNIX operating system and relational databases. UNIX Kernel level expertise and exposure to Communication Protocols are necessary requirements for the Systems Developers. Applications design and development skills utilising INFORMIX, ORACLE or INGRES within recognised structured methodology environments are necessary requirements for the Technical Consultants.

Address up until 14th December 1989
38 Buckingham Palace Road, London, SW1W 0RE.
Tel: 01-828 9744 Fax: 01-828 2712

Address from 15th December 1989
Hamilton House, 1 Temple Avenue, London, EC4Y 0HA.
Tel: 01-353 4212 Fax: 01-353 3325

During the evening please Tel: 01-536 0170

CAD - Cambridge - to £22,000

Due to the expansion of their software development operation, this manufacturer has a number of positions available for Software Engineers with experience of CAD systems, GIS software and systems tools. To qualify, you need to be a graduate with experience of C, Pascal or Fortran and UNIX or VMS. Extensive involvement with software design, and implementation is a prerequisite and project co-ordination experience will be a distinct advantage.

PRE-POST SALES AND TECHNICAL SUPPORT PROFESSIONALS
£15,000-£25,000 + Car
(Midlands, London, Home Counties)

Are you a Support Professional looking for:

- ▲ **A Change in direction?**
- ▲ **A new challenge?**
- ▲ **A higher salary?**

Do you have experience of:

- ▲ **'C'** ▲ **UNIX?** ▲ **DOS?**
- ▲ **4GLs and Relational Databases?**

If you have answered yes to any of the questions posed or are unsure of your correct answer, why not give us a call to make an initial enquiry about positions currently available.

John Brown
associates

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The Activator allows the software **developer** the option to program serial numbers, versions, or other pertinent data known only to the developer, into the circuit, and access it from the program.

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Full 100% Disclosure

Since The Activator is protected by our patent we fully disclose how it works. Once you understand it, endless methods of protection become evident.

Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.

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